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ORIGINAL ARTICLES.

I.—Eminent Living Geologists: Alfred Richard Cecil Selwyn, C.M.G., LL.D., F.R.S., F.G.S., etc.

(WITH A PORTRAIT, PLATE II.)

THE number of eminent living geologists surviving since the days of De la Beche and Ramsay and the beginnings of the Geological Survey must indeed be very few, but in Dr. A. R. C. Selwyn, the subject of this brief notice, we have a living illustration of one of those active and energetic early workers whose labours have extended from Britain to Australia and Canada, and who, after half a century of active service in the field, is now enjoying his well-merited repose in British Columbia, "the land of the far West."

Alfred R. C. Selwyn, the son of the Rev. Townshend Selwyn, Canon of Gloucester, was born in 1824, and educated in Switzerland, where he early imbibed a passion for geology. In the year 1845, at the age of 21, he was first employed on the Geological Survey of Great Britain, and received his earliest lessons in the art of geological surveying from A. C. Ramsay; but he soon proved himself so proficient in the work of field-surveying that he was speedily entrusted with the task of mapping a large tract of intricate Lower Silurian rocks in North Wales, which he carried out in a masterly manner.

At that time Sir Henry De la Beche had charge of the whole organization of the Geological Survey, with the title of Director-General. The immediate supervision of the work in England and Wales (and afterwards in Scotland) was assigned to A. C. Ramsay, as local Director for Great Britain. Edward Forbes was appointed Palæontologist; Sir W. W. Smyth became Mining Geologist; Sir Joseph Hooker, Botanist; Dr. Lyon Playfair, Chemist; Richard Phillips was in charge of the Laboratory and Museum; and Robert Hunt, Keeper of Mining Records. The staff of Geological Surveyors under Ramsay comprised W. T. Aveline, Trevor E. James, D. H. Williams, H. W. Bristow, W. H. Baily, and A. R. C. Selwyn. R. Gibbs was the Collector of Fossils, and proved to be one of the best men in that capacity ever attached to the staff of the Survey. Mr. C. R. Bone was employed as Artist to draw fossils described by the Palæontologist; and Mr. J. W. Lowry was Engraver both of the plates of fossils and of most of the early geological sections. Never since has the Survey been so admirably equipped.

Of this excellent body of geological workers only Sir Joseph Hooker, W. T. Aveline, and A. R. C. Selwyn remain to us; the others have all gone over to the majority. This is also true of Oldham, J. Phillips, Murchison, J. W. Salter, J. Beete Jukes, and some others who joined the Survey before Selwyn's retirement. Of the older members who joined afterwards, E. Hull, H. H. Howell, G. H. Kinahan, and Robert Etheridge still survive.

In November, 1845, we find Selwyn located at Machynlleth, and accompanying Ramsay in making some traverses into the rugged country of Cader Idris, from which in subsequent years they were to work out the complicated volcanic geology of North Wales.

In May and June, 1846, Selwyn was at work from Dolgelly, and Aveline was tracing the boundaries of the Silurian series from Llanbrynmair eastwards to Church Stretton and the Longmynd. Ramsay spent much time with Selwyn, and records "glorious days and glorious scenery"; "out with Selwyn along the front of the Cader cliffs," and "over the top of Cader Idris; a long day's work and a splendid scramble." He also adds, "Selwyn's work good."

In August, 1847, we find Selwyn located at Ffestiniog, where he was joined by Ramsay, Playfair, Jukes, and Gibbs; Ramsay (having accidentally sprained his ankle) was mounted on a pony and went over the ground with his colleagues, and discussed with them some of the problems met with in the course of their mapping.

In the Autumn of that year Selwyn was at Capel Curig, and Jukes at Yspytty Evan. Before the end of the year Jukes was transferred to the South Staffordshire Coalfield. Writing to Ramsay (Oct. 15, 1847) Jukes says: "It so happens that the last time I saw Selwyn, we were mutually wishing that you would send us both into Staffordshire together."[1] This proposal was not, however, adopted. After leaving North Wales, Selwyn carried on the Geological Survey work in parts of Shropshire, as far north as the Liassic outlier of Prees. To show that a kindred spirit moved the two young geologists, we find them in 1848 communicating a joint paper to the London Geological Society on their North Wales investigations.[2]

Whilst quartered at Port Madoc and Dolgelly in June, 1848, Selwyn was once more visited by Ramsay, and together they went forth again to the hills south-west of Craig-y-Cae, "mapping in some faults and a lot of strange dykes and spots of squirted traps." Ramsay writes: "Selwyn and I separated and took different ground, and often met again to compare and compile. A lovely day, and the (cloud) effects over the valley of Dolgellaw and the towering range of Cader Idris most strange and glorious."

In October, when Selwyn was at Beddgelert, mapping the Snowdon area, we find him visited by Ramsay, who was quartered at Llanberis. Ramsay writes: "Started for the hills at the top of

[1] See Letters, etc., of J. B. Jukes, 1871, pp. 302, 314, 322, and 341.

[2] A. R. C. Selwyn & J. B. Jukes, "Sketch of the Structure of the Country extending from Cader Idris to Moel Siabod, North Wales": Quart. Journ. Geol. Soc., vol. iv (1848), pp. 300–302.

the Pass, and sent Gibbs to search the ridge of Snowdon; Sir Henry De la Beche and Forbes followed an hour later for the top. While at work on the side of Crib-goch I heard Selwyn's well-known shrill shout, and soon discovered him on the top of a crag on Crib-goch. So we joined and compared notes, and soon put matters straight at Glaslyn. We then passed on to the top, often standing to discuss, and just as we got to the bottom of the peak descried our party coming down."

Perhaps the most enjoyable episodes of this geological life in Wales, the memory of which would be long cherished, were the occasional interchange of visits of members of the staff with each other, and those paid them by their energetic chief, Sir Henry De la Beche, from London. Whilst Ramsay and Forbes were staying at Llanberis, Selwyn, who was located at Beddgelert,[1] would sometimes walk across the hills and spend the evening and night with Ramsay, who in turn occasionally crossed the watershed and landed in time for dinner at Beddgelert. Many pleasant stories were recorded in the principality of the sayings and doings of these jolly hammerers long years after they themselves had left the scene of their labours for other, and in Selwyn's case distant, shores.

In September, 1849, Mr. Selwyn, having completed the survey of the ground lying between the Snowdon range on the north and Ffestiniog and Tremadoc on the south, turned his attention to working out the Lleyn peninsula from Pwlheli. In December of the same year he again joined Ramsay and Jukes at Aber, where they appear to have had a very pleasant meeting,—"joking and making fun, all of us, all night," says Ramsay. (Life of Ramsay, p. 158.)

On the 30th April, 1850, Selwyn, Jukes, and Ramsay once more met at Merchlyn in North Wales. There were still various unfinished parts to complete, likewise sundry lines regarding which they had to confer with their colleagues.

Ramsay records that he was "out on the hills with Selwyn [on the 4th May, 1850] as far as the cliffs under Carnedd Llewelyn and down by Melynllyn and Llyndulyn. Got some good work done." He adds: "Selwyn executed a most perilous feat of cliff-climbing; a slip and he would have been slain" (op. cit., p. 161). Writing to Salter on the 31st May, 1850, from Caernarvon, Ramsay says: "Selwyn and I are here putting a final touch to all the difficulties and erst-seeming contradictions on this side the Straits"; and on the 12th October he was "helping Selwyn to put some finishing touches to the mapping of the Cader Idris region." How many *final touches* we wonder have been added towards the elucidation of these Welsh geological difficulties in the subsequent half-century! Again, quoting from the life of Sir Andrew Ramsay: "There still remained a portion of Anglesey to be surveyed before the maps of North Wales could be regarded as complete and ready for the engraver. De la Beche had himself traced the lines across some parts of that county, and other portions had been mapped by

[1] September, October, 1848.

W. W. Smyth. Ramsay and Selwyn (early in November, 1850) crossed into Anglesey with the object of filling in the unfinished portions and completing the whole" (p. 171). "During the day he and Selwyn traversed the rocky northern coast of the island, charmed with 'the cliffy foregrounds, the white breakers, the great misty plains of Anglesey, and the snow-covered mountains rising beyond so still and grandly.' At night they had the shelter of little inns, sometimes of the homeliest kind" (p. 173), and once they received an invitation to make the Rectory of Llanfairynghornwy their head-quarters for a day or two. It was during this investigation that, in a letter to Ramsay, November 11th, 1850, De la Beche intimated to him that he had recognized conglomerates at the base of the Cambrian series of Anglesey, and that most probably the rocks underlying these were of *pre*-Cambrian age. Selwyn clearly detected the unconformability of the lowest Cambrian strata upon an older series of schists, but Ramsay on this occasion differed from De la Beche and Selwyn, and on the maps published by him no pre-Cambrian rocks were there shown.

One is struck by the conviction that the labours of the conscientious geologist are never-ending, for we find that in October, 1851, "There were still points of detail and some questions of interpretation of geological structure to be settled in the area in North Wales mapped by Ramsay and Selwyn. Selwyn accordingly had gone back to Dolgelli to look into these, and there Ramsay joined him." Ramsay writes in his diary, October 17th, 1851: "Held a council with Selwyn on the Shropshire sheets, etc. His work there and here [North Wales] is the perfection of beauty" (op. cit., p. 193). "One of the most striking in the whole series of sections published by the Geological Survey" (writes Sir A. Geikie) "runs from the top of Snowdon parallel with the Llanberis valley to the Menai Straits at Llanfair, whence it was afterwards continued across Anglesey. On the other side it was prolonged south-eastwards into the country mapped by Selwyn, and was carried by him into Merionethshire, across Cynicht, Moel Wyn, and Aran Mowddwy, and was continued by Aveline across Montgomeryshire." Sir A. Geikie adds: "The geological structure is portrayed by Ramsay and Selwyn with a boldness and vigour, and at the same time with an artistic feeling, which had hardly been equalled in geological section-drawing" (op. cit., p. 165).

Ramsay records that in 1851 Selwyn was present, 18th January, at the annual dinner of the Survey, known as "the Royal Hammerers." "And oh, wasn't it a jolly dinner!" No doubt he had also been present at many earlier gatherings.

The Welsh work of completion and revision took longer than had been anticipated. At the close of 1852 it was not finished; and Selwyn relinquished the happy Survey days at the end of July in that year. For, following the blessed example set by his former colleagues, Thomas Oldham, Edward Forbes, and A. C. Ramsay, Mr. Selwyn also became a Benedict, and took to himself a wife, Matilda Charlotte, daughter of the Rev. Edward Selwyn, rector of

Hemingford Abbotts, Hunts; and in the year following he was appointed by the Colonial Office Director of the Geological Survey of the newly-formed Colony of Victoria,[1] Australia, which had just then entered upon all the excitement and interest of the opening up of its wonderful goldfields. Here Selwyn's past experiences in unravelling the intricate Lower Silurian rocks of North Wales, with their associated volcanic deposits, served him in good stead in mapping the Silurian strata of Victoria, with its gold-bearing rocks and auriferous gravels of different ages, and in tracing the relations of the latter to the Miocene beds of the Colony, so rich in their varied Eocene molluscan fauna.

Mr. Selwyn was ably assisted by C. S. Wilkinson, H. Y. L. Brown, C. B. Brown, R. Etheridge, jun., and other geologists; and in addition to an admirable series of geologically coloured maps of the Colony and reports, he made the following important communications:—

1. "On the Geology and Mineralogy of Mount Alexander and the adjacent country lying between the Rivers Loddon and Campaspe": Quart. Journ. Geol. Soc., vol. x (1854), pp. 299–303.
2. "Report on the Geological Relations of some of the Coal-seams of Van Diemen's Land, their probable extent, and relative economic value": Van Diemen's Land, Roy. Soc. Papers, iii, 1855–9, pp. 116–141.
3. "On the Geology of the Goldfields of Victoria": Quart. Journ. Geol. Soc., vol. xiv (1858), pp. 533–538; and Geologist, vol. i (1858), pp. 163, 164.
4. "Notes on the Geology of Victoria": Quart. Journ. Geol. Soc., vol. xvi (1860), pp. 145–150.
5. "Geological Notes of a Journey in South Australia from Cape Jervis to Mount Serle": Geogr. Soc. Proc., vol. v (1861), pp. 242–244.
6. "Report on the Auriferous Drifts and Quartz-reefs of Victoria.—Observations on the probable Age of the 'Lower Gold Drifts'": Victoria, Australia, May 4, 1866. Reprinted in the Geol. Mag., Vol. III (1866), pp. 457–459.

The communication made to the Geological Society by Mr. Selwyn on March 10, 1858, and the Report on Auriferous Drifts, etc., Victoria, 1866 (Geol. Mag., Vol. III, p. 457), are among the most important of Mr. Selwyn's written contributions to the geology of Victoria.

He was almost continually engaged in the field with his assistants, or in travelling over the Colony, and was indefatigable in the discharge of his duties as Director of the Survey from 1853 to 1869, when he retired, the Survey having been brought to an abrupt close by the Colonial Legislature refusing to vote the necessary supplies to carry on the work.

In 1865 Mr. Selwyn sent over to the care of the late Mr. H. M. Jenkins, at that time Assistant Secretary of the Geological Society, an excellent collection of Murray River Tertiary shells, which have since been deposited in the Museum of the Geological Society, Burlington House.[2]

[1] The *whole area* of the Principality of Wales is 7,378 square miles: Victoria is the smallest of the Australian colonies and its area is 87,884 square miles! What a contrast for Selwyn after seven years among the mountains of Wales!

[2] For a most interesting account of the Tertiary deposits of Victoria, based upon Mr. Selwyn's reports and papers, see British Association, Section C (Geology), Norwich, 1868; and Geol. Mag., Vol. V (1868), p. 566, by H. M. Jenkins, F.G.S.

Mr. Selwyn's geological services were, however, far too valuable to be permitted to lie fallow for any length of time, and on the retirement of his old friend Sir William Logan, that same year (1869), from the office of Director of the Canadian Geological and Natural History Survey, Montreal, Logan recommended the Canadian Government to appoint Selwyn as his successor, a piece of advice which they at once accepted and acted upon.

Although, from the commencement of his geological career, Selwyn's life had been one of almost incessant and active labour in the field and in the office, he could scarcely have found a more energetic man to follow after than Sir William Logan, or a wider field to travel over than the Dominion of Canada. This territory is nearly as large as Europe, stretches from the Atlantic to the Pacific Ocean, and is estimated to contain a total area of 3,315,647 square miles, *exclusive* of the great lakes and rivers.

His staff, though small, included such well-known geologists as Mr. James Richardson, Dr. Robert Bell, Dr. T. Sterry Hunt, the present Director (Dr. G. M. Dawson, C.M.G.), J. B. Tyrrell, J. F. Whiteaves, B. J. Harrington, H. M. Ami, A. H. Foord, and some others, Mr. E. Billings being the chief palæontologist.

During the 25 years, from 1869 to 1894, that Mr. Selwyn filled the office of Director of the Geological Survey of Canada, twenty large volumes of Annual Reports, with accompanying maps and sections, were issued from the Survey Offices in Montreal or later on from Ottawa. In addition to these, five other volumes were published by Billings, Macoun, and Dawson on Invertebrata and Plants; four fascicules by A. H. Foord, E. O. Ulrich, T. Rupert Jones, and Dr. Rüst on Micropalæontology; and four by J. F. Whiteaves on Palæozoic and Mesozoic fossils.

Notwithstanding the arduous administrative duties which Selwyn was called to fulfil in planning out the work to be carried on by his staff, and arranging all matters relating to the expenditure of his grant, as well as in editing the reports of his assistants and writing his own, he yet found time to traverse and personally explore large extents of unmapped territory. This was at a time when maps were few and bad, when no railways and but few roads existed, and long journeys had to be performed by boat or in the saddle, and often on foot, in order to reach points of vantage for geological and trigonometrical surveying. Add to all this the necessity of having to camp out and carry supplies sufficient for three months, and one begins to realize that a geologist's life in a large and mainly unexplored country, such as the backwoods of Canada, is not always an altogether happy one.

In addition to these arduous duties, the Dominion Government called upon Mr. Selwyn to act as Assistant to the Canadian Commissioners at the Centennial Exhibition held in Philadelphia in 1876, at the Paris Universal Exhibition in 1878, and at the Colonial and Indian Exhibition in London in 1886; involving an enormous amount of labour, and including the preparation of descriptive catalogues of the economic minerals and notes on the

stratigraphical rocks exhibited in the Canadian Court on each occasion.

Of his miscellaneous writings there are not many to record at this time, but the following may be noted:—

7. "On the Discovery of Reptilian Footprints in Nova Scotia": Geol. Mag., Vol. IX (1872), pp. 250, 251.
8. "Notes on a Journey through the North-West Territory, from Manitoba to Rocky Mountain House" (1874): Canadian Naturalist, vol. vii (1875).
9. "The Stratigraphy of the Quebec Group and the older Crystalline Rocks of Canada" (1879): Canadian Naturalist, vol. ix (1881), pp. 17–31.

In 1871 Mr. Selwyn was elected a Fellow of the Geological Society of London, and in 1874 a Fellow of the Royal Society.

In 1876 he was awarded the "Murchison Medal" by the Council of the Geological Society of London—"in recognition of his services to Silurian geology. . . . . As one of the officers of the Geological Survey of this country, engaged in unravelling the intricate Lower Silurian rocks of North Wales with their associated volcanic deposits; as afterwards in charge of the Geological Survey of Victoria, mapping its Silurian strata, its gold-bearing rocks and auriferous gravels of different ages, and tracing the relations of the latter to the Miocene beds of the colony and to the older rocks; as subsequently the successor of Sir William Logan in the direction of the Geological Survey in our North American territories from the Atlantic to the Pacific Ocean, the labours of Mr. Selwyn have extended over an enormous field. How successfully he has worked in it, the numerous and excellent maps and sections executed under his superintendence, and his various reports and papers, fully testify.

"There is something peculiarly appropriate in the Medal founded by Sir Roderick Murchison being given to one whose labours, like his own, have lain so much among Silurian and Palæozoic rocks, among goldfields, and in the direction of geological surveys. While it marks [said the President] our appreciation of Mr. Selwyn's services to Geology, it will, I trust, not be less welcome to him as a proof that, though absent, he is not forgotten at home."[1]

In the course of his fifty years' work as a geologist, Mr. Selwyn has been spontaneously elected to more than fourteen scientific societies in various parts of the world, including the K.-k. Geologischen Reichsanstalt Wien. He was created C.M.G. in 1886.

It would be impossible in such a notice as this to do full justice to so eminent and illustrious a geologist, but we trust that what has here been so imperfectly written may serve to "keep his memory green" in the recollection of some of those friends who, like the writer, can recall Mr. Selwyn, not only by means of his written memoirs, but by a personal knowledge of the man and his worth.[2]

H. W.

[1] See President's speech, Feb. 18, 1876: Quart. Journ. Geol. Soc. Lond. (Proceedings), vol. xxxii, p. 49.

[2] The writer is much indebted to Sir A. Geikie's "Life of Ramsay"; to his friend J. F. Whiteaves, F.G.S., for various references; and to G. Pringle Hughes, Esq., J.P., Middleton Hall, Wooler, Northumberland, for the photograph here reproduced, and for valuable information, a part of which is embodied in this notice.

II.—Professor Hull "On the Submerged Platform of Western Europe."

By the Rev. Osmond Fisher, M.A., F.G.S.

TO appreciate more fully Professor Hull's interesting paper "On the Submerged Terraces and River Valleys bordering the British Isles," it is necessary to refer to the Transactions of the Victoria Institute,[1] in which the paper is illustrated by a map showing the contour-lines and soundings. The author thinks that the steep descent from the surface of the 100-fathom plateau to the abyssal floor of the Atlantic is analogous to an escarpment, instancing the Cotteswold Hills and other examples, and argues from this that the steep descent in question has been due to the forces of subaerial denudation, and has had a terrestrial origin. But in his "general conclusion" he mentions marine as well as atmospheric erosion. This seems to show that he does not exclude the supposition of the descent being possibly an ancient sea cliff, to which one would think it more analogous than to an escarpment, for, as Mr. Jukes-Browne observes, the latter term implies the termination of a series of beds of one geological age, which it cannot be supposed occurs here.

I notice that in this discussion there has been no reference made to a masterly paper by the late Mr. R. A. C. Godwin-Austen—"On the Valleys of the English Channel."[2] He tells us that he "had frequent opportunities of cruising about this Channel, and had been enabled at one time or another to visit nearly every portion of its shores on either side, and to examine its bed with the dredge and sounding-lead." The map which illustrates his paper consequently gives several interesting points of detail, which do not appear in the Admiralty chart of the English Channel. He says that "along the opening of the Channel there is an obvious configuration of hill and valley, and an amount of inequality equal to that of the most mountainous parts of Wales." Regarding the junction of the channel with the Atlantic we read—"Beyond the 200-fathom line the outline is irregular, and sinks rapidly to very great depths. This remarkable fact occurs not only at one particular spot, but is continued northwards, and in the contrary direction has been traced by Captain Vanhello from Cape Finisterre to the parallel of the Lizard." He states that the ridge of the Little Sole Bank is placed on the east edge of the 200-fathom line. "Of the true nature of such a sudden line of depression we can at present only form conjectures. It may represent lines of old escarpments, or, should lines of sea cliffs have gone down rapidly into deep water where no mechanical action could modify them, such features would be preserved. Lines of faults and upheaval would also prevent such unequal soundings; but the outline is too irregular to represent the termination of the sedimentary mass of the present seas; besides which we have constant indications of a surface of bare rock."

[1] Vol. xxx (1898).

[2] Quart. Journ. Geol. Soc., vol. vi (1849), p. 69.

It is clear that Godwin-Austen's conclusions are quite compatible with the existence of the river-valleys, which Professor Hull thinks that he has traced, and he appears to consider that the landscape of the Channel, if it were laid bare, would be very diversified. He also appears to regard this landscape as the outcome of long-continued agencies, both marine and terrestrial, while, if I understand him rightly, he attributes the original formation of the Channel valley to plication dating from Eocene times. As regards the remark that of the true nature of the sudden line of depression from the continental plateau to the ocean floor we can only form conjectures, will it not help us in our conjectures to notice the very remarkable parallelism between the outlines of the western coast of the Old World and the eastern of the New? Surely there must be a cause for this peculiar feature in some way connected with the formation of the basin of the Atlantic. It seems as if a single original continent had been split into two masses, which had subsequently separated. This idea appears to have occurred to M. A. Snider, but I have been unable to get a sight of his work.[1] Two of his diagrams are copied into "Pepper's Playbook of Metals."

If there is any foundation for such a supposition, the edges of the continental plateaux on the opposite sides of the Atlantic ought to be the two sides of the rent, and ought to fit one another still more accurately than the coastal profiles do, because in the lapse of ages these would have become much modified. Would it not be worth while for those who have been studying the two plateaux to notice whether this is the case?

I have offered a speculation on the *cause* of this great rent in *Nature*[2] and subsequently in my "Physics of the Earth's Crust,"[3] and it is not needful to recapitulate it here.

III.—Preliminary Note on *Prolimulus Woodwardi*, Fritsch, from the Permian Gaskohle at Nyřan, Bohemia.

By Dr. Ant. Fritsch,
Director of the Royal Bohemian Museum in Prague.

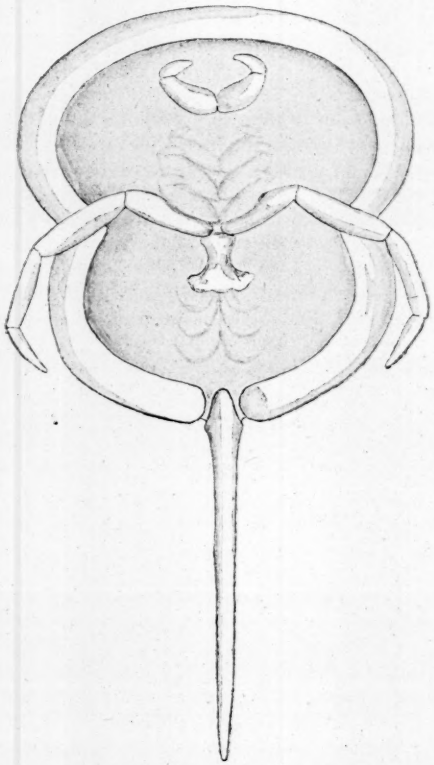
SOME years ago I received a fossil preserved in pyrites from the Gaskohle at Nyřan. No details could be seen under the microscope, and I was not sure if it were a *Limulus* or a seed. At an exhibition by Architects held last year at Prague I saw a specimen of a similar fossil with two of its appendages preserved, and I was fortunate enough to acquire the same for our Museum. I then re-examined all my material previously collected, and found appendages in other specimens also. Several plates with drawings of these objects will appear in the second part of the fourth volume of my work, "Fauna der Gaskohle," but as this work will require more than a year before it can be published, I hasten to give a preliminary sketch of this Permian Xiphosure, which I dedicate to my friend Dr. Henry Woodward, one of the chief authorities on fossil Crustacea in England.

[1] "La Création et ses Mystères dévoilés."

[2] Vol. xxv (1882), p. 243.

[3] Second edition (1889), chap. xxv.

The body consists of two rounded shields, with thickened margins measuring 13 mm., the telson is 14 mm. in length, the whole length of the specimen being 27 mm.



Diagrammatic sketch of *Prolimulus Woodwardi*, Fritsch, enlarged four times.

The dorsal surface is generally covered with some calcareous coiled discoidal tubes of *Spiroglyphus vorax*, Fr. On the ventral part of the cephalothorax (if made wet with gum-arabic) five pairs of extremities can be detected, the first being very strongly curved inwards, the fifth long and slender, being supported by a sternal element.

On the ventral surface of the abdomen we can see rounded plates, probably the modified abdominal appendages covering the respiratory organs, or branchiæ. The telson is inserted in an invagination of the hinder margin of the abdomen.

I hope that the galvanoplastic casts which I have had prepared of some of the developed natural impressions will help us to recognize more of the details of the structure of this Permo-Carboniferous king-crab. *Prolimulus* very closely resembles one of the embryonic stages of the living North American *Limulus polyphæmus*.

The earliest known Limuloid Crustacean, named *Neolimulus falcatus*, figured and described by Dr. H. Woodward in 1868 (see GEOL. MAG., Vol. V, p. 1, Pl. I, Figs. 1, 1*a*), is from the Upper Silurian of Lesmahagow, Lanarkshire, Scotland. Mr. W. H. Baily described *Bellinurus Kiltorkensis*, Baily (1869), from the Upper Old Red Sandstone, Kiltorcan, Ireland. The genus *Bellinurus* was established by Mr. C. König, in 1820, for certain small king-crabs from the Coal-measures of Coalbrookdale, Shropshire, under the specific name of *B. bellulus*. To this have been added *B. arcuatus* and *B. reginæ*, Baily (1863), Coal-measures, Queen's County, Ireland; *B. Kœnigianus*, H. Woodw. (1872), Coal-measures, Dudley; *B. Danæ*, Meek & Worthen, Coal-measures, Illinois, U. S. America; *Prestwichia*[1] (*Limulus*) *anthrax*, Prestwich, sp. (1840), and *P. rotundata*, Prestwich, sp., Coal-measures, Coalbrookdale, Shropshire; and *P. Birtwelli*, H. Woodw. (1872), Coal-measures, Padiham, Lancashire.

King-crabs have been described from the Muschelkalk,[2] the Jurassic, the Cretaceous rocks, the Tertiaries, and are now living in the seas of Eastern North America and of Japan. Our present Permo-Carboniferous example connects the Upper Coal-measures with the Secondary rocks, and completes the chain of life of this remarkably persistent type of the Xiphosura from the Upper Silurian to the present day.

IV.—On a Section in the Westleton Beds at Ayot Brickfield.

By Horace W. Monckton, F.L.S., F.G.S.

ON May 14th, 1898, a party of the Geologists' Association visited Ayot under the direction of Messrs. John Hopkinson, F.G.S., and A. E. Salter, B.Sc., F.G.S. An account of the excursion will be found in the Proceedings of the Association, vol. xv, p. 308, and I think the following additional note of one of the sections visited will be of interest.

The section was at the eastern side of the brickfield close to Ayot station, and the general relation of the beds seen is shown in the accompanying Figure.

Prestwich, in his paper on the "Relation of the Westleton Beds," etc., published in 1890,[3] remarks: "Notwithstanding the extreme denudation which the high chalk plain extending from Hertfordshire into Bedfordshire, Buckinghamshire, and Oxfordshire has undergone, a few small outliers of Lower Tertiary strata still remain, rising above the general level of the chalk plateau with its scanty Glacial Drifts and its 'Red Clay with flints.' These little isolated hills are frequently capped by a gravel- or shingle-bed, which I believe to be of Westleton age." He then gives several localities, and amongst them Ayot, 406 feet O.D.

[1] Originally described by Prestwich in his "Geology of Coalbrookdale" as '*Limulus*' *anthrax*. The genus *Prestwichia* was established by Woodward in 1867: see Quart. Journ. Geol. Soc., vol. xxiii, p. 32.

[2] *Limulus priscus*, Münster, Muschelkalk-Dolomit, Laineck, near Bayreuth: K. A. Zittel's "Handbuch der Palæontologie," ii, p. 645 (1881).

[3] Quart. Journ. Geol. Soc., vol. xlvi, p. 138.

Thus I take it that Prestwich would have classed the gravel-bed 2 in the above section as Westleton Beds, and its composition and appearance favour the view that it does belong to the gravels which Prestwich assigns to that series in this part of England.

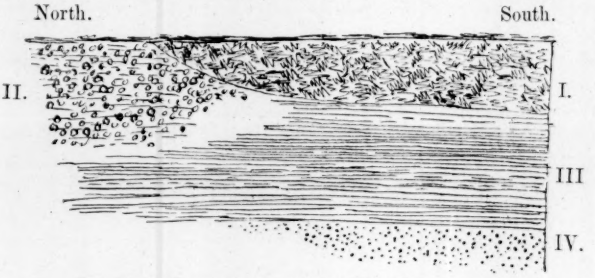


Diagram-Section in the Ayot Brickfield.

Level of surface nearly 400 feet O.D.

I. Boulder-clay, about 12 feet shown, containing pebbles of chalk, etc.
II. Stratified gravel and sand (Westleton).
III. London Clay.
IV. Loamy sand—Basement Bed, London Clay.

N.B.—The junction of beds 2 and 3 was hidden by talus. The section is drawn from a rough sketch and was about 30 feet in depth.

A short examination showed that it is composed mainly of flint pebbles, derived no doubt for the most part from the wreck of Tertiary pebble-beds; subangular flints are fairly common, as also are quartz pebbles. I noticed several pebbles of whitish quartzite, one of which measured 5 inches in longest diameter. The gravel was clearly stratified.

Assuming, therefore, that we have here the Westleton Beds of Prestwich, the point to which I wish to draw attention is the manner in which the section illustrates their relation to the Chalky Boulder-clay. This sufficiently appears from the above sketch. The Boulder-clay rests against the Westleton Bed in the north of the pit, but has cut through it on the south, and lies directly on London Clay. A very similar section on the railway between Chapple and Mark's Tey is given by Prestwich, fig. 7, at p. 132 of the paper mentioned above.

V.—Note on a Table of Contemporary Geological Deposits arranged Stratigraphically, with their Characteristic Genera of Mammalia.

By Dr. C. I. Forsyth-Major, Corr. Memb. Zool. Soc. Lond.

THE subjoined list of characteristic genera of Mammalia has been compiled, at the request of my friend Dr. Henry Woodward, for the purpose of being used as a descriptive Table to be fixed on the wall of the Mammalian Gallery in the Geological Department of the British Museum (Natural History), and has been arranged in the form which was thought to be most suitable for the purpose.

I have only a few remarks to offer with regard to some points in

which I have given expression to views not in accordance with those generally accepted.

In assigning the deposits of Pikermi, Mont Léberon, Samos, Maragha, etc., to the Upper Miocene rather than to the Lower Pliocene, as advocated by the majority of palæontologists, I am not aware that the considerations which formerly led me to hold this view have since been invalidated. At the locality Raphina, near the sea-shore, about four miles from Pikermi, Th. Fuchs came upon layers intercalated with the deepest strata of the Pikermi formation and containing the following shells: *Ostræa edulis*, *Spondylus gæderopus*, *Cerithium*, *Balanus*, all of which still live in the adjoining sea, and present a very recent aspect ("das äussere Ansehen dieser Fossilien ist äusserst jugendlich, wie quaternär"). Fuchs considers them to be contemporaneous with the Pikermi formation; as it was impossible, however, to collocate the latter with the Pleistocene, he resorted to a sort of compromise by assigning both to a very recent Pliocene. None of the palæontologists who have studied the fauna of Pikermi, Maragha, Mont Léberon, Samos, etc., could arrive at a similar conclusion; but in order to reconcile the two seemingly conflicting occurrences, a further compromise was resorted to, and Pikermi, etc., became 'Lower Pliocene.' The shells being, however, undoubtedly Pleistocene, the only possible explanation is the one given by De Stefani, viz., that their intercalation with the Pikermi formation is the result of a secondary *remaniement* of this latter by the sea. I think that better arguments than those deduced from the presence of the Raphina shells ought to be brought forward, if the Pikermi and allied formations are to be maintained in the Lower Pliocene.

With regard to the classification of the Jurassic Mammalia as '? Monotremata,' I have to offer the following explanation:—Part of them, the Multituberculata (Allotheria), are considered by some authors to have affinities with the Monotremata, and are consequently placed in the same subclass, 'Prototheria,' with the latter, whilst others prefer to assign them to a distinct suborder, collocated between the Monotremata and Marsupialia. The majority of Mesozoic remains, those provided with numerous teeth, are by almost common consent united with the Polyprotodont Marsupialia. With regard to the latter point, it has been observed by Winge that the simple forms of the teeth and their large number in *Myrmecobius*, several Edentates and Cetacea, are not a primitive character, but the consequences of a sort of degeneration; and further, that the shape of the posterior part of the mandible in the Triconodontidæ is quite different from that in Marsupialia. Besides, there is some ground for the assumption that the Marsupialia are merely an outcome of the Placentalia.

Therefore, with regard to the Jurassic 'Mammals' generally, since their mammalian nature has not yet been raised beyond every doubt, it seemed more prudent to include them all under the head of the subclass or order which presents more affinities with the Reptilia than do the Marsupialia or Placentalia.

SYSTEM.	PROBABLE CONTEMPORARY DEPOSITS.	CHARACTERISTIC GENERA OF MAMMALIA.
PLEISTOCENE.	Peat; Alluvium; Loess. Valley-gravels; Brickearths. Cave-deposits; Raised beaches.	Proboscidea.—Mastodon, Elephas. Perissodactyla.—Rhinoceros, Elasmotherium, Equus. Artiodactyla.—Hippopotamus, Sus, Phacochœrus; Moschus, Cervus, Cervalces, Alces, Rangifer, Capreolus; Saïga, Rupicapra, Gazella, Oreas, Cobus, Boselaphus; Ovibos; Bubalus, Bison, Bos; Capra, Ovis; Camelopardalis (Libytherium). Sirenia.—Rhytina. Rodentia.—Prolagus, Lagomys, Sylvilagus, Lepus; Castor, Trogontherium, Sciurus, Arctomys, Spermophilus; Myoxus, Muscardinus; Pellegrinia; Hystrix, Sminthus, Alactaga, Siphneus, Ellobius, Spalax, Cricetus, Myodes, Microtus, Mus. Chiroptera.—Rhinolophus, Plecotus, Vespertilio, Vesperugo. Carnivora.—Ursus; Canis, Cyon; Hyæna; Meles; Herpestes, Gulo, Mustela, Putorius; Felis, Machairodus. Primates.—Macacus; Homo.
	Cave deposits, Peat, Lacustrine deposits (Madagascar).	Artiodactyla.—Potamochœrus, Hippopotamus. Rodentia.—Brachyuromys, etc. Insectivora.—Centetes, Oryzorictes, Microgale. Primates.—Megaladapis, Archæolemur, Dinolemur, Thaumastolemur, Globilemur; Nesopithecus.
LOWER PLEISTOCENE.	Forest Bed (Norfolk Coast). Saint-Prest; Durfort, etc.—(France). Leffe; Arezzo; Rome—(Italy). Equus and Megalonyx Beds (U.S.A.).	Edentata.—Megalonyx, Mylodon, Glyptodon, Chlamydotherium. Proboscidea.—Elephas, Mastodon. Perissodactyla.—Tapirus; Rhinoceros, Equus. Artiodactyla.—Hippopotamus, Dicotyles, Sus; Cervus, Cariacus, Capreolus, Alces; Gazella, Bubalus, Bison, Bos; Camelus, Camelops, Eschatius, Auchenia. Rodentia.—Prolagus, Lagomys, Lepus; Trogontherium, Castor, Castoroides; Sciurus, Arctomys; Erethizon, Hydrochœrus; Thomomys, Geomys; Zapus; Neotoma, Microtus, Mus. Insectivora.—Talpa, Scalops; Myogale; Sorex, Crossopus, Crocidura. Carnivora.—Procyon, Arctodus; Ursus, Canis, Cyon, Urocyon; Hyæna; Mustela, Lutra, Mephitis; Arctotherium, Felis, Machairodus. Primates.—Macacus; Homo.

LOWER PLEISTOCENE.	**Pampas Formation (S. America).**	MARSUPIALIA.—Didelphys, Dimerodon. EDENTATA.—Myrmecophaga; Megatherium, Mylodon, Pseudolestodon, Lestodon, Scelidotherium, Platyonyx, Glossotherium; Glyptodon, Hoplophorus, Panochthus, Dædicurus; Chlamydophorus, Dasypotherium, Chlamydotherium, Tatusia, Tolypeutes, Xenurus. PROBOSCIDEA.—Mastodon. PERISSODACTYLA.—Toxodon, Dilobon ('Toxodontia'); Typotherium, Pachyrucos ('Typotheria'); Hippidium, Equus; Macrauchenia; Tapirus. ARTIODACTYLA.—Dicotyles; Cervus, Coassus; Auchenia, Mesolama, Palæolama, Protauchenia. RODENTIA.—Sylvilagus; Myopotamus, Ctenomys, Dicœlophorus, Pithanotomys, Schizodon, Loncheres, Cavia, Hydrochœrus, Lagostomus; Hesperomys, Habrothrix, Nectomys, Rheithrodon, Holochilus. PRIMATES.—Homo.
	Central Australia.	MONOTREMATA.—Proëchidna. MARSUPIALIA.—Pseudochirus, Dasyurus, Thylacinus, Thylacoleo, Pseudochirus, Koalemus; Macropus, Sthenurus, Procoptodon, Palorchestes, Diprotodon, Nototherium; Phascolomys, Phascolonus. CARNIVORA.—Canis.
UPPER PLIOCENE.	**Upper Siwaliks (India).** **Pithecanthropus Beds, Trinil (Java).** **Borneo.** **Kos (Asia Minor).** **Red Crag, partim (Suffolk and Essex).** **Montpellier, partim; Perrier; Ardé; Coupet—(France).** **Astigiano; Upper and Lower Val d'Arno; Olivola—(Italy).** **? Blanco (U.S.A.).**	EDENTATA.—Manis. PROBOSCIDEA.—Elephas, Mastodon. PERISSODACTYLA.—Tapirus; Rhinoceros; Equus. ARTIODACTYLA.—Hippopotamus; Platygonus, Sus; Probubalus, Amphibos, Bubalus; Leptobos, Bison, Bos; Camelopardalis; Boselaphus, Tragelaphus, Palæoryx; Capra; Cervus; Pliauchenia. RODENTIA.—Lagomys, Caprolagus; Castor; Hystrix; Microtus, Nesokia. CARNIVORA.—Ælurus, Ursus, Canis, Viverra, Hyæna, Lepthyæna; Mellivora, Mustela, Enhydriodon, Lutra; Machairodus, Felis. PRIMATES.—Macacus, Semnopithecus; Pithecanthropus.

SYSTEM.	PROBABLE CONTEMPORARY DEPOSITS.	CHARACTERISTIC GENERA OF MAMMALIA.
LOWER PLIOCENE.	Siwaliks, partim (India). Eppelsheim (Germany). Casino (Tuscany). Montpellier, partim; Roussillon—(France). Alcoy (Spain). Red and Coralline Crags (England), partim. Antwerp Crag (Belgium). ? Blanco (U.S.A.).	PROBOSCIDEA.—Dinotherium, Mastodon. PERISSODACTYLA.—Rhinoceros; Tapirus; Hipparion, Hippidium. ANCYLOPODA.—Chalicotherium. ARTIODACTYLA.—Hippopotamus (Hexaprotodon), Sus; Hyæmoschus; Palæoryx, Gazella; Cervus, Capreolus; Phiauchenia. INSECTIVORA.—Talpa, Crocidura. RODENTIA.—Prolagus, Caprolagus; Castor; Ruscinomys; Rhizomys, Trilophomys. CETACEA.—Squalodon; Eurhinodelphis. Priscodelphinus, Schizodelphis; Globicephalus; Tursiops, Orca; Physeter; Hoplocetus, Hyperoodon, Choneziphius, Dioplodon, Berardiopsis, Plesiocetus, Isocetus, Balænoptera, Megaptera, Balæna. SIRENIA.—Halitherium (Felsinotherium). CARNIVORA FISSIPEDIA.—Hyænarctos, Ursus; Hyæna, Viverra; Simocyon, Vulpes; Machairodus, Caracal, Felis. CARNIVORA PINNIPEDIA.—Pristiphoca, Monatherium, Palæophoca, Mesotaria, Callophoca. PRIMATES.—Semnopithecus, Macacus, Dolicopithecus, Cynocephalus, Anthropopithecus.
? LOWER PLIOCENE.	Araucanian Formation, Monte Hermoso (Argentina).	MARSUPIALIA.—Didelphys. EDENTATA.—Lestodon, Megatherium, Scelidotherium. Pseudolestodon; Glyptodon, Hoplophorus, Panochthus, Neuryurus; Chlamydotherium, Dasypus, Dasypotherium, Proeuphractus. UNGULATA.—Toxodon, Trachythærus; Protypotherium, Typotherium; Tapirus; Hippidium, Macrauchenia, Epitherium; Auchenia, Eoauchenia, Paraceros. RODENTIA.—Myopotamus, Tribodon, Eumysops, Pithanotomys, Megamys, Microcavia, Palæocavia, Hydrochœrus. CARNIVORA.—Canis.

UPPER MIOCENE.	**Siwaliks, partim (India).** **Maragha (Persia).** **Samos (Asia Minor).** **Pikermi (Attica).** **Baltavar (Hungary).** **Belvedere (Austria).** **Monte Bamboli; Casteani—(Tuscany).** **Mont Léberon; Croix-Rousse, etc.—(France).** **Concud (Spain).** **Loup Fork (U.S.A.).**	PROBOSCIDEA.—Dinotherium, Mastodon. EDENTATA.—Orycteropus. PERISSODACTYLA.—Hyrax; Aceratherium, Teleoceras, Aphelops; Tapiravus; Anchitherium, Hipparion, Protohippus. ANCYLOPODA.—Chalicotherium. ARTIODACTYLA.—Hippohyus, Sus; Sivatherium, Bramatherium, Helladotherium, Palæotragus, Samotherium; Tragoceros, Criotherium, Bucapra; Palæoryx, Protoryx, Helicophora, Prostrepsiceros, Gazella; Blastomeryx, Cervus. RODENTIA.—Panolax; Eucastor; Hystrix; Hesperomys, Acanthomys. CHIROPTERA.—Vespertilio. CARNIVORA.—Hyænarctos, Leptarctos; Ælurodon, Simocyon; Hyænictis, Ictitherium, Hyæna, Lycyæna; Promeles, Promephitis; Lutra, Brachypsalis. PRIMATES.—Mesopithecus, Oreopithecus.
? UPPER MIOCENE.	**Patagonian Formation (Argentina).**	MARSUPIALIA.—Apera, Cynonasua. EDENTATA.—Promegatherium, Interodon, Promylodon, Nephrotherium; Hoplophorus, Protoglyptodon; Proeuphractus, Chlamydotherium. UNGULATA.—Toxodon, Protypotherium; Proterotherium; Scalabrinotherium; Macrauchenia. RODENTIA.—Discolomys, Morenia, Eucardiodon, Lagostomus, Megamys, Briaromys. CETACEA.—Pontistes, Pontivaga, Balæna, Notiocetus. SIRENIA.—Ribodon.
MIDDLE MIOCENE.	**Dinotherium Sands [Georgensgmünd, Steinheim, Nördlingen, Günzburg] (Germany).** **Sansan, St. Gaudens, Grive St. Alban—(France).** **San Isidro (Spain).** **(Not represented in N. America.)**	PROBOSCIDEA.—Dinotherium; Mastodon (angustidens). PERISSODACTYLA.—Aceratherium, Rhinoceros; Anchitherium. ANCYLOPODA.—Macrotherium. [Micromeryx. ARTIODACTYLA.—Listriodon, Hyotherium; Dicrocerus, Palæomeryx, Procervulus, RODENTIA.—Titanomys, Prolagus, Lagopsis; Steneofiber, Xerus, Sciuropterus, Sciurus; Myoxus; Cricetodon. INSECTIVORA.—Galerix; Lantanotherium, Myogale; Talpa; Sorex; Dimylus. CHIROPTERA.—Pteropus; Vespertilio. CARNIVORA.—Amphicyon, Hemicyon, Dinocyon; Hyænarctos, Ursus (?); Palæogale, Stenogale; Trochictis, Trochotherium, Pseudælurus. PRIMATES.—Dryopithecus; Pliopithecus.

SYSTEM.	PROBABLE CONTEMPORARY DEPOSITS.	CHARACTERISTIC GENERA OF MAMMALIA.
? **MIDDLE MIOCENE.**	**Santa Cruz Formation (Argentina).**	MARSUPIALIA (incl. 'SPARASSODONTIA'). — Microbiotherium, Prodidelphys, Eodidelphys, Stylognathus, Prothylacinus, Abderites, Acdestis, Epanorthus, Callomenus, Garzonia; Borhyæna, Hathlyacynus, Dinamyctis, Conodynictis, Cladosictis, Amphiproviverra. EDENTATA.—Hapalops; Pseudhapalops, Hyperleptus, Pelecyodon; Prepotherium; Planops; Analcitherium; Asterostemma; Prodasypus; Peltephilus. UNGULATA.—Protypotherium, Icochilus; Pachyrucos; Nesodon; Acrotherium; Adiantus, Theosodon; Proterotherium, Licaphrium; Diadiaphorus, Astrapotherium; Homalodontotherium. RODENTIA.—Steiromys, Acaremys; Neoreomys, Perimys; Eocardia, Procardia, Dicardia. ? INSECTIVORA.—Necrolestes. PRIMATES.—Homunculus, Anthropops.
LOWER MIOCENE (? UPPER OLIGOCENE).	**Weisenau n. Mayence; Ulm—(Germ.). St. Gérand-le-Puy; Calcaire de Beauce —(France). Schio strata, Belluno (Italy). John Day Beds (Western N. America).**	MARSUPIALIA.—Oxygomphius, Didelphys. AMBLYPODA.—Moropus. PERISSODACTYLA.—Diceratherium; Tapirus; Aceratherium. ARTIODACTYLA. — Elotherium; Merycochœrus, Merychyus, Palæochœrus; Agriochœrus; Dremotherium, Cænotherium; Plesiomeryx (gracilis); Gomphotherium. RODENTIA.—Titanomys, Palæolagus; Allomys; Archæomys, Theridomys, Issiodoromys; Pleurolicus, Entoptychus; Hesperomys, Cricetodon. INSECTIVORA.—Plesiosorex; Talpa. CARNIVORA.—Hyænodon; Amphicyon; Temnocyon; Hyænocyon, Enhydrocyon; Palæogale; Potamotherium; Proælurus, Hoplophoneus, Nimravus. SIRENIA.—Halitherium (bellunense).
? **LOWER MIOCENE.**	**Pyrotherium Beds (Argentina).**	MARSUPIALIA.—Polydolops, Epanorthus; Proborhyæna, Pharsophorus. EDENTATA PRIMITIVA.—Notostylops, Anastylops, Parastylops. EDENTATA.—Orophodon, Hapalops; Palæopeltis; Proeutatus; Peltephilus. ? CONDYLARTHRA.—Didolodus; Propteriptychus. ? PROBOSCIDEA PRIMITIVA.—Pyrotherium. UNGULATA. — Archæophylus, Prosotherium, Eutrachytherus; Archæohyrax, Argyrohyrax; Leontinia, Asmodeus, Isotemnus, Trimerostephanus; Parastrapotherium, Deuterotherium, Adiantus, Notohippus, Coresodon, Morphippus, Rhynchippus. RODENTIA.—Cephalomys, Asteromys, Orchiomys. PRIMATES.—Notopithecus, Archæopithecus.

OLIGOCENE.	**Hempstead (Isle of Wight).** **Phosphorites, part.; Ronzon (France).** **Rochette (Switzerland).** **Cadibona; Zovencedo—(Italy).** **White River Beds (Western North America).**	MARSUPIALIA.—Amphiperatherium, Didelphys. PERISSODACTYLA.—Titanotherium, Metamynodon; Aceratherium, Leptaceratherium; Lophiodon, Helaletes, Colodon; Mesohippus. ARTIODACTYLA.—Elotherium; Oreodon, Agriochœrus; Anthracotherium; Protoceras; Gelocus; Plesiomeryx, Leptomeryx; Poëbrotherium. RODENTIA.—Palæolagus; Ischiromys; Theridomys; Steneofiber; Gymnoptychus; Eumys, Cricetodon. INSECTIVORA.—Ictops, Leptictis. CHIROPTERA.—Domnina. CARNIVORA.—Hyænodon; Cynodon, Daphænos; Plesictis, Hoplophoneus, Dinictis. SIRENIA.—Halitherium (H. Schinzi, H. Chouqueti). PRIMATES.—Laopithecus, Menotherium.
UPPER EOCENE.	**Bembridge (Isle of Wight); Hordwell (Hants).** **Gypsum of Montmartre (Paris).** **Sands of Beauchamps (France).** **French Phosphorites (partim).** **Lignites of Débruge (Vaucluse).** **Bohnerz of Switzerland and South Germany: Egerkingen, Mauremont, Delsberg; Fronstetten, Ulm, Heidenheim, Pappenheim (partim).** **Monte Zuello (Italy).** **Uinta Formation; Arkansas; Alabama—(U.S.A.).**	MARSUPIALIA.—Didelphys. CETACEA.—Zeuglodon. SIRENIA.—Halitherium (veronense). AMBLYPODA.—Uintatherium. PERISSODACTYLA.—Palæotherium, Lophiotherium, Anchilophus, Lophiodon, Protapirus, Schizotherium, Cadurcotherium; Telmatotherium, Amynodon, Diplacodon, Triplopus, Epihippus, Helaletes. ARTIODACTYLA.—Anoplotherium, Diplobune; Dichobune, Gelocus, Plesiomeryx (cadurcense), Xiphodon; Chœropotamus; Leptotragulus, Protoreodon, Elotherium. RODENTIA.—Pseudosciurus, Sciuroides, Theridomys, Trechomys, Eomys; Paramys, Protoptychus. INSECTIVORA.—Amphidozotherium, Neurogymnurus. CHIROPTERA.—Vespertiliavus, Hipposideros. CREODONTA.—Pterodon, Hyænodon, Proviverra, Cynohyænodon, Quercytherium; Mesonyx. CARNIVORA.—Cynodictis, Cynodon, Plesiocyon, Cephalogale, Pseudamphicyon, Stenoplesictis, Palæoprionodon, Palæogale, Amphictis, Pseudælurus. PRIMATES.—Adapis, Microchœrus, Cœnopithecus, Cryptopithecus; Hyopsodus, Microsyops.

SYSTEM.	PROBABLE CONTEMPORARY DEPOSITS.	CHARACTERISTIC GENERA OF MAMMALIA.
MIDDLE EOCENE.	**Bracklesham (Sussex).** **Egerkingen and Mauremont (Switzerland, partim).** **Argenton ; Issel—(France).** **Buchsweiler (Alsace).** **Bridger Formation (Wyoming, North America).** **Jamaica (Limestone).**	MARSUPIALIA.—Didelphys. SIRENIA.—Prorastomus, Halitherium. AMBLYPODA.—Dinoceras, Uintatherium, Tinoceras. PERISSODACTYLA.— Lophiodon, Palæotapirus, Paloplotherium, Pachynolophus, Hyracotherium ; Lambdotherium, Helaletes, Hyrachyus, Palæosyops, Limnosyops. ARTIODACTYLA.—Dichobune ; Achænodon, Homacodon. RODENTIA.—Paramys, Tillomys. INSECTIVORA.—Ictops. CHIROPTERA.—Nyctilestes, Nyctitherium. CREODONTA.—Mesonyx, Proviverra, Protopsalis, Miacis, Didymictus, Patriofelis. PRIMATES. — Hyopsodus, Tomitherium, Omomys, Notharctus, Limnotherium, Microsyops.
LOWER EOCENE.	**London Clay.** **Paris Basin.** **Egerkingen, Switzerland (partim).** **Wasatch Formation (North America).**	MARSUPIALIA.—Didelphys. CONDYLARTHRA.—Phenacodus, Protogonia, Meniscotherium. PERISSODACTYLA. — Hyracotherium, Pachynolophus, Lophiodon, Eohippus, Heptodon, Systemodon. ARTIODACTYLA.—Pantolestes, Lophiodochœrus, Protodichobune. AMBLYPODA.—Coryphodon, Ectacodon. TILLODONTIA.—Esthonyx. RODENTIA.—Paramys, Decticadapis. INSECTIVORA.—Diacodon, Centelodon. CREODONTA.—Proviverra, Cynohyænodon, Pachyæna, Amblyctonus, Didelphodus. CARNIVORA.—Palæonyctis, Oxyæna. PRIMATES.—Hyopsodus, Lemuravus, Tomitherium, Microsyops, Anaptomorphus.

BASE OF EOCENE.	**Cernay Conglomerates ; La Fère—(France).** **Torrejon (New Mexico).** **Puerco (New Mexico).**	ALLOTHERIA.—Neoplagiaulax, Liotomus ; Catopsalis, Polymastodon, Ptilodus, Chirox. EDENTATA.—Hemiganus, Psittacotherium, Onychodectes, Conoryctes. CONDYLARTHRA. — Pleuraspidotherium, Orthaspidotherium ; Protogonodon, Euprotogonia, Periptychus, Anisonchus, Hemithlæus, Haploconus, Mioclænus, Protoselene. AMBLYPODA.—Pantolambda. RODENTIA PRIMITIVA.—Plesiadapis, Protoadapis ; Mixodectes. ? INSECTIVORA.—Adapisorex. CREODONTA. — Procynictis, Dissacus, Hyænodictis, Protoviverra, Arctocyon ; Oxyclænus, Protochriacus, Chriacus, Tricentes, Deltatherium, Triisodon, Sarcothraustes, Microclænodon, Clænodon. ? PRIMATES.—Indrodon.
UPPER CRETACEOUS.	**Ceratops Beds, Laramie (W. N. Amer.).**	MULTITUBERCULATA INCERTÆ SEDIS. (1) ? MONOTREMATA. PLAGIAULACIDÆ. — Cimolestes, Didelphops, Cimolomys, Pediomys, Ptilodus, Meniscoëssus, Allacodon. (2) Synconodon, Ectoconodon, Protolambda.
JURASSIC.	**Purbeck Beds (Dorsetshire) ; Stonesfield Slate (Oxfordshire).** **Atlantosaurus Beds, Colorado, etc. (Western N. America).**	? MONOTREMATA. TRICONODONTIDÆ.—Phascolotherium, Triconodon, Spalacotherium. AMPHILESTIDÆ.—Amphilestes, Dicrocynodon, Docodon. AMBLOTHERIDÆ.—Dryolestes, Amblotherium, Asthenodon. PLAGIAULACIDÆ (Multituberculata).—Plagiaulax, Ctenacodon, Allodon, Bolodon.
TRIAS.	**Frome (Somersetshire).** **Echterdingen (Würtemberg).** **Conn. River Beds (N. America).**	? Microlestes. ? Dromatherium, ? Microconodon.

NOTICES OF MEMOIRS.

I.—The Action of Waves and Tides on the Movement of Material on the Sea-coast. By W. H. Wheeler, M.Inst.C.E., Boston, Lincolnshire.[1]

THE object of this paper is to show the relative effect of waves due to wind and tidal action on littoral drift. It is pointed out that all cliffs that border the sea-coast are doomed to erosion, and the material derived from their destruction, after being sorted and prepared by waves and tidal action, is conveyed to the depths of the sea. The function of wind waves is to break down the cliffs, to sort the material displaced, and to reduce the larger rock fragments into sizes sufficiently small to be acted on by the tides, and to disperse material that has been collected in large masses by tidal action. The function of the tides consists in raising the water of the ocean sufficiently high to enable the waves to attack the cliffs, in assisting in the grinding up of the reduced rock fragments by their perpetual oscillating motion until sufficiently reduced in size, and then in transporting them to the bed of the sea, the latter operation being effected either in solution, suspension, or rolling along the bottom.

It is shown that all material eroded from the cliffs is ultimately carried seaward, and that the sea yields nothing to the land. The only agents capable of transporting material of greater specific gravity than the water are the waves, and their action, until they break on the shore, is merely one of undulation; and therefore it is only the stones, shingle, or sand which lie shorewards of the point where the wave breaks that can be carried forward on to the beach. On the other hand, the slope of the beach being seawards, all material has a natural tendency to work downwards under the action of gravity, this downward action being aided by the undertow of the retiring shore waves.

Material eroded from the cliffs consists of rock fragments, boulders, sand, and alluvium. The alluvium, consisting of particles of sufficient minuteness to remain in suspension for a considerable time, is diffused by the waves over a very considerable distance, and is finally deposited in the deep part of the ocean; the sand is gradually worked down the beach by the action of the waves and tides, and is also spread over the sea bed, but nearer to the shore; the rock fragments are reduced to shingle small enough to be acted on by the tides, and in this condition are rolled up and down the beach and drifted along the coast until ground into particles sufficiently fine to be transported to the sea. Shingle is generally accumulated in banks in the zone lying between low-water of neap tides and high-water of spring tides, and travels along the coast in one given direction. The heaping up and travel of the shingle is due to tidal action. The effect of wind waves due to gales is principally destructive to shingle banks, cutting out and dispersing the material, the banks being restored by tidal action in calm weather and during offshore winds. The action of waves due to wind is intermittent, variable in direction, and irregular. The travel of shingle, except when acted

[1] Read before Sect. C (Geology), British Association, Bristol Meeting, Sept. 1898.

on by gales, is continuous, regular, and constant in direction. It is shown by a number of examples that the travel of shingle is not coincident either with the prevailing or predominant winds, but on a tidal coast the predominant drift is invariably in the same direction as that of the flood tide. The action of the tides in heaping up and drifting material is due to wave action. The rise and fall of the tide on the coast does not consist of a mere vertical rise and fall of the water, but of a continual oscillation. The crest of the tidal wave in the open sea, being in advance of that near the shore, results in an oblique lateral movement along the beach, and the advance of the water being checked by the shallow bed with which it comes in contact, is reflected back, resulting in a series of small oscillations or waves which break when they reach the low-water line. These oscillations are ever present on the margin of the shore, even when the sea is calmest, and are never absent except when absorbed by larger waves due to gales. These tidal wavelets vary in height from 6 inches to 2 feet, and break on the shore at the rate of from ten to twenty a minute according to the rise of the tide and the slope of the beach. These wavelets, aided by the flood current, lift up and carry forward any coarse sand, loose stones, or other material with which they come in contact, and leave some portion of it stranded at the highest point to which the tide of the day reaches. The wavelets, besides lifting and transporting the shingle, brush upward the whole of the face of the bank, and gradually raise it above the line of high-water. It is shown that, though these waves are small, they by their weight and velocity develop sufficient force to move a large quantity of pebbles. A wave having a height of only a foot from trough to crest, giving a head of 6 inches, and containing a volume of water equal to a weight of ·142 ton has sufficient kinetic energy to raise 165 lbs. of pebbles a foot high. Allowing the weight of pebbles in water to be 100 lbs. to the cubic foot, each wave, if the whole of its energy be applied to the movement of the material, is capable of raising 660 pebbles 2 inches in diameter a foot; or, with fifteen waves to the minute, 9,900 pebbles a minute and 2,376,000 in a single tide, or a total weight of stone of 266·4 tons a foot high. This, however, is beyond the work actually done, as a portion of the energy of the wave is absorbed in friction. The above rough approximation of the power of the wavelets is sufficient to show the enormous power that is developed by tidal action day by day on the coast, and the capability of the wavelets due to the tides for building up shingle banks and drifting the pebbles along the beach.

II.—Leadhillite in Ancient Lead Slags from the Mendip Hills.[1] By L. J. Spencer, M.A., F.G.S., British Museum (Natural History).

LEAD ores have been worked in the Mendip Hills (East Somerset) ever since the time of the Romans; but during the present century operations have been chiefly confined to the reworking of the

[1] Read before Sect. C (Geology), British Association, Bristol Meeting, Sept. 1898.

old waste heaps of slags and slimes. From these heaps upwards of 9,000 tons of lead was extracted during the ten years ending 1880. The material now being worked at Priddy has the appearance of a brown earth: it contains fragments of charcoal and limestone, and about 6 per cent. of lead as carbonate. Embedded here and there in this material are blocks consisting of devitrified slag, partially fused galena, and fragments of charcoal; and in the cavities numerous small crystals of cerussite ($PbCO_3$) and anglesite ($PbSO_4$) and, less frequently, of leadhillite.

Leadhillite has not been before observed under such conditions. In the Roman lead slags at Laurion in Greece, which have been in contact with sea-water, Lacroix has noted the following secondary minerals: matlockite, penfieldite, laurionite, fiedlerite, phosgenite, cerussite, hydrocerussite, and anglesite.

The colourless crystals of Mendip leadhillite have, perpendicular to the perfect basal cleavage, an acute negative bisectrix with an optic axial angle in air of $2E=72\frac{3}{4}°$; at a temperature of 97° C., $2E=70\frac{1}{2}°$. The frequent twinning and the goniometric measurements (which are, however, not very good) are not inconsistent with the orthorhombic symmetry insisted upon by Miller. The basal planes of complicated twin crystals always give a single sharp reflected image, which is not the case with twin crystals of ordinary monosymmetric leadhillite. A few crystals are optically uniaxial.

There therefore seem to be three kinds of leadhillite, all of which are identical in outward appearance: (*a*) Monosymmetric, with the optic axial angle $2E=20°$; (*b*) rhombohedral (?) and optically uniaxial (susannite); (*c*) orthorhombic, with $2E=72\frac{3}{4}°$.

Before 1874 the formula for leadhillite was given as $PbSO_4.3PbCO_3$, and that now usually accepted is $PbSO_4.2PbCO_3.Pb(OH)_2$; but no two of the several analyses that have been made are in close agreement, and other formulæ have been proposed. Doubtless each of the above kinds has a definite chemical composition, and the variations shown by the different analyses are possibly due to the fact that two—(*a*) and (*b*) or (*b*) and (*c*)—of the three kinds may occur together in the same crystal, as observed by Bertrand and by myself in specimens from Leadhills. It will therefore be necessary to examine optically each fragment that is collected for future analyses of leadhillite.

III.—Gigantic Irish Deer-Remains.—Report of the Committee, consisting of Professor W. Boyd Dawkins (Chairman), His Honour Deemster Gill, the Rev. E. B. Savage, Mr. G. W. Lamplugh, and Mr. P. M. C. Kermode (Secretary), appointed to examine the Conditions under which remains of the Gigantic Irish Deer are found in the Isle of Man.[1]

WE were able to add a footnote to our report of last year to the effect that a fairly perfect skeleton of *Cervus giganteus* had been discovered, of which we hoped to hand in details with this year's report. These remains were found in a marl-pit at Close-y-

[1] Communicated to the British Association, Bristol, September, 1898, Section C (Geology).

Garey, on the east side of the railway line, half a mile north from St. John's, and the same distance south from Poortown station.

The bones were nearly all in juxtaposition and, excepting the ribs and pelvic bones and one shoulder-blade, in a very fair state of preservation. The antlers were nearly complete; the beams, however, are represented by fragments, the skull also is fragmentary.

The left antler is the larger; it measures across the palm 15 inches, allowing for a piece of the front edge which has decayed away; the right measures 13 inches. With the tines, most of which dropped off on lifting from the marl, they are respectively 56½ inches and 53 inches long, and the beam would have been about 10 inches more. They show six points, besides the brow-tines, which had fallen off, the portion of the beam to which they were attached having decayed away.

The palm of the left antler lay over the lumbar vertebræ, and the right over the fore-quarters. The upper jaw teeth were preserved on both sides, and those of the left lower jaw were embedded in the ramus. A fragment of the right symphysis was also present, and there were various fragments of a skull which had been broken up before the discovery.

One of the ribs had been perforated, probably by the point of an antler of another elk in one of their usual fights. It was fractured as well as perforated, and had been healed. This injury, therefore, was not connected with the death of the animal, which took place in its full prime, as shown by the perfection of the teeth and the dimensions of the antlers.

Professor Boyd Dawkins examined the bones in December and made the measurements of the skeleton found at Close-y-Garey.

Excavation No. 1 in disturbed soil yielded fragments of upper jaw (teeth worn) of *Cervus giganteus.*

The skeleton lay in white marl at a depth of about 9 feet from the present surface, on its right side, the legs drawn up to the body, the head towards the margin of the ancient pool, now a morass, which lies in a hollow in the glacial drifts.

From the position of the bones the animal appeared to have died where it was found, not to have been washed down by floods. About sixty years ago the bog had been worked for marl, and the present well-defined banks mark out a rectangular hollow some 50 yards square and about 3 feet below the surrounding surface.

Across one corner of this a trench was dug to carry off the water, and the operations of the Committee were confined to a triangular area on the west side of the trench, measuring about 15 yards east and west, by about 30 yards north and south. They excavated all over this space to a depth of over 9 feet. The first four excavations, being through ground which had previously been disturbed, yielded no definite results, but at one point a few bones were met with, among which were fragments of maxilla, the sixth cervical vertebra, the second lumbar vertebra, and a fragment of a rib. In association with these were remains of horse represented by a radius and lower jaws of two individuals. Though the ground

had been disturbed the horse bones probably belonged to the same age as the Great Deer. A fragment of a metatarsal, met with in digging the trench, had an artificial perforation.

The result of all the excavations, allowing for the disturbed state of the ground, showed the following beds :—

		Ft.	in.
A.	Disturbed soil and peat, an average of about	3	0
B.	In one place a blue clay or silt was observed resting on the white marl.		
C.	White marl containing the remains of the Gigantic Deer	6	6
D.	Blue marl [1]...	1	0
E.	Red sand with gravel	0	3
F.	Brown clay	0	3
G.	Sand and gravel } ? Glacial drift {	0	3
H.	Clay ... ... } {	4	0

As stated above, the whole surface had been lowered about 3 feet in digging for marl; the peat had for the most part been removed, and a great deal of the marl also; indeed, we were fortunate in finding this one spot in which the marl itself had not been disturbed.

The finding of detached bones shows that other individuals had perished here, and is consistent with what we were told, that a specimen had been seen when digging for marl, and that the antlers of another had been taken out. We were told also that two skulls without antlers had been seen on the other side of our trench.

Samples of the marl and other beds were forwarded to Mr. James Bennie, of Edinburgh, who again most kindly undertook the laborious task of washing and sifting the material. The organic remains thus obtained were examined by Mr. Clement Reid, who has determined the following plants :—

From Peat B.

Ranunculus flammula, L.
Viola palustris, L.
Rubus fruticosus, L. (very small).
Potentilla tormentilla, Neck.
,, *comarum*, Nestl.
Carduus crispus, L.
Menyanthes trifoliata, L.
Empetrum nigrum, L.
Potamogeton, sp.
Carex, 4 sp.

Also beetles, 3 sp., and caddis cases.

From Marl C.

Ranunculus repens, L.
Viola palustris, L.
Potentilla comarum, Nestl.
Myriophyllum spicatum, L.
Rumex obtusifolius, L.
Empetrum nigrum, L.
Potamogeton, sp.
Carex, 4 sp.
Chara, sp.
Umbelliferous plant (unripe).

From Red Sand D.

Plant-remains, not determined.

From Bed E.

Betula alba.
Potamogeton, sp.
Carex, sp.
Bracts of sedge.
Leaves (?).

Mr. R. Okell examined the White Marl for Diatoms, but found no trace. There are no fresh-water shells in it.

[1] This was noticed below the skeleton, and may have been discoloured by the decay of the body.

In our last report we were able to announce the discovery in a previous excavation near Ballough of the Arctic crustacean *Lepidurus glacialis*, and accompanied by the Arctic willow *Salix herbacea* in a bed of silt occurring above *Chara*-marl, like that of the present section. In that locality, however, we did not succeed in finding elk-remains in the marl, probably on account of the limited character of our excavation, as we have every reason to believe that the skeleton now in Edinburgh Museum was obtained from that bed. In the present instance, though we have found the elk, it will be noticed that the section contains no trace of the Arctic fauna. This is greatly to be regretted, since—as was pointed out by Mr. C. Reid in our last report—the relation of this fauna to the bed containing the elk is a point of great theoretical importance. It is also important that the presence of the horse in the wild fauna of the Isle of Man should be placed beyond doubt by working in undisturbed ground. The same group of animals may be expected as that which occurs in the prehistoric strata of Ireland and England. Under these circumstances we propose to apply for a further grant to carry on explorations which will probably definitely settle these interesting questions.

The balance of the grant, renewed last year, was expended in the preliminary work of draining; further funds, which enabled the Committee to continue the work and to exhume the specimen which has now been set up in Castle Rushen, Isle of Man, were provided by the local Society, which also contributed the amount required for mounting the skeleton.

The best thanks of the Committee are due to Messrs. C. Reid, J. Bennie, and R. Okell for the valuable assistance they have rendered in the investigation.

IV.—Supplementary List of British Minerals.[1] By L. J. Spencer, M.A., F.G.S., British Museum (Natural History).

During the forty years which have elapsed since the publication of Greg and Lettsom's "Manual of the Mineralogy of Great Britain and Ireland," a considerable number of species, variety and other names have been added to the list of minerals occurring in the British Isles. In 1858 Greg and Lettsom recognized 241 British species, but of these only 209 are given as numbered species by Dana in the sixth edition (1892) of his "System of Mineralogy." To this list may now be added 84 more, bringing the total number of British species up to 293, as compared with the total of 824 known mineral species recognized by Dana in 1892. Owing to the difficulty in some cases of defining a mineral species, to the uncertainty of some of the determinations, and to the fact that a systematic search through the whole of the literature has not yet been made, these numbers can only be considered approximate.

Some of the most notable additions are of minerals which have been detected by the microscopical examination of rock-sections,

[1] Read before Sect. C (Geology), British Association, Bristol Meeting, Sept. 1898.

e.g., nephelite, nosean, and various felspars, pyroxenes, and amphiboles.

In the following list are added 113 other names which have been applied to British minerals; the species are distinguished by italics. The first observer and date have been added (in parenthesis) wherever possible; in other cases the earliest reference found is given.

Abriachanite (Heddle, 1879).
Achroite (Collins, 1876).
Ægirite (Teall, 1888).
Aikinite (Museum Pract. Geol.).
Albertite (Morrison, 1884).
Alunogen (Smithe, 1882).
Amazon stone (Heddle, 1877).
Amblystegite (Judd, 1885).
Andesine (Heddle, 1877).
Andrewsite (Maskelyne, 1871).
Anorthite (Haughton, 1856).
Antigorite (Heddle, 1878).
Antimony ? (Garby, 1848).
Atacamite (Church, 1865).
Balvraidite (Heddle, 1880).
Baricalcite (Breithaupt, 1841).
Barytocelestite (Collie, 1878).
Bastite.
Bathvillite (Williams, 1863).
Bauxite (Sutherland, 1870).
Bayldonite (Church, 1865).
Beekite.
Beraunite (Greg, 1860).
Bhreckite (Heddle, 1879).
Botallackite (Church, 1865).
Bowlingite (Hannay, 1877).
Braunite ? (Collins, 1871).
Bruiachite (Macadam, 1886).
Bytownite (Teall, 1884).
Cantonite (Davies, 1877).
Cathkinite (Glen & Young, 1882).
Celadonite (Heddle, 1879).
Centrallassite (How, 1878).
Chalcosiderite (Maskelyne, 1875).
Chenevixite (Adam, 1866).
Chloritoid (Heddle, 1879).
Chloropal (Church, 1866).
Chlorophyllite (Heddle, 1882).
Chrome-diopside (Teall, 1888).
Chrysoberyl (Haughton, 1856).
Chrysotile.
Churchite (Church, 1865).
Cleavelandite (Heddle, 1877).
Clinochlore (British Museum).
Cloustonite (Heddle, 1880).
Coccolite (Heddle, 1877).
Collyrite (Gladstone, 1862).
Cotterite (Harkness, 1878).
Craigtonite (Heddle, 1882).
Crocidolite (Heddle, 1879).
Cryptolite (Church, 1872).
Danalite (Miers & Prior, 1892).
Daphnite (Tschermak, 1891).
Delessite (Heddle, 1879).
Demidoffite (Greg, 1860).
Descloizite (Frenzel, 1875).
Devilline (Pisani, 1864).
Dolianite (Des Cloizeaux, 1862).
Dudgeonite (Heddle, 1889).
Dufrenite (Kinch & Butler, 1886).
Duporthite (Collins, 1877).
Edenite (Heddle, 1878).
Electrum (Forbes, 1867).
Ellonite (Heddle, 1882).
Enstatite.
Enysite (Collins, 1876).
Eosite (Schrauf, 1871).
Eulytite (Collins, 1881).
Evansite (Woodward, 1884).
Ferrite (Heddle, 1882).
Fibrolite (Heddle, 1882).
Fichtelite (Macadam, 1889).
Freieslebenite ? (Museum Pract. Geol.).
Funkite (Heddle, 1882).
Genthite (Heddle, 1878).
Gersdorffite (Forbes, 1868).
Gigantolite (Heddle, 1882).
Glaucophane (Blake, 1888).
Gramenite (Collins, 1877).
Grastite (Heddle, 1878).
Grossular (Heddle, 1878).
Grünlingite (Muthmann & Schröder, '97).
Halloysite (Heddle, 1882).
Haughtonite (Heddle, 1879).
Hausmannite (Goodchild, 1875).
Henwoodite (Collins, 1876).
Hibbertite (Heddle, 1878).
Hisingerite (Church, 1870).
Hovite (Gladstone, 1862).
Hullite (Hardman, 1878).
Hydrated labradorite (Heddle, 1880).
Hydrocerussite (Heddle, 1889).
Hydrophilite (Spiller, 1876).
Hydroplumbite (Heddle, 1889).
Hydrozincite (Goodchild, 1883).
Iddingsite ? (Arnold-Bemrose, 1894).
Igelströmite (Heddle, 1878).
Inverarite (Heddle, 1883).
Jarrowite (Lebour, 1887).
Johannite ? (Garby, 1848).
Langite (Maskelyne, 1864).
Latrobite (Heddle, 1877).
Lepidomelane (Haughton, 1859).
Lettsomite (British Museum).
Leuchtenbergite (Glen & Young, 1876).
Leucoxene (Geikie, 1879).

Limnite (Church, 1865).
Linnæite (Terrill & Des Cloizeaux, 1880).
Liskeardite (Maskelyne, 1878).
Loganite (Harkness, 1866).
Löllingite (Collins, 1871).
Ludlamite (Field, 1877).
Lussatite (Mallard, 1890).
Lyellite (Maskelyne, 1864).
Marmolite (Heddle, 1878).
Martite (Heddle, 1882).
Massicot ? (Collins, 1871).
Melanite (Teall, 1892).
Microcline.
Mirabilite (Glen & Young, 1876).
Monazite (Miers, 1885).
Montmorillonite (Collins, 1878).
Mottramite (Roscoe, 1876).
Mountain silk, etc. (Heddle, 1879).
Necronite (Heddle, 1877).
Neotype (Breithaupt, 1841).
Nephelite (Allport, 1871).
Nephrite (Heddle, 1878).
Nosean (Allport, 1874).
Okenite (Glen & Young, 1876).
Oligoclase (Haughton, 1862).
Omphacite (Teall, 1891).
Orangite (Heddle, 1883).
Ottrelite (Hutchings, 1889).
Pargasite (Heddle, 1878).
Penninite (Heddle, 1878).
Penwithite (Collins, 1878).
Perthite (Heddle, 1883).
Phlogopite ? (Heddle, 1878).
Pickeringite (British Museum).
Picotite (Bonney, 1877).
Pierolite (Heddle, 1878).
Piedmontite (Dana, 1892).
Pihlite (Heddle, 1879).
Pilolite (Heddle, 1879).
Plumboaragonite (Collie, 1889).
Plumbogummite (Dana, 1850).
Plumbonacrite (Heddle, 1889).
Polybasite (Joy, 1860).
Polytelite (Forbes, 1867).
Prasilite (Thomson, 1840).
Protolithionite (Sandberger, 1885).
Proustite (British Museum).
Pseudo-hypersthene, etc. (Heddle, 1878).
Pseudophite (Heddle, 1879).
Pyroaurite (Heddle, 1878).
Pyrophyllite (Foster, 1876).
Pyrosclerite (Heddle, 1879).
Reichite (Breithaupt, 1865).
Restormelite (Church, 1870).
Rhabdophane (Lettsom, 1878).
Riebeckite (Harker, 1888).
Rock silk, etc. (Heddle, 1879).
Rubislite (Heddle, 1879).
Sanidine.
Scapolite (Ormerod, 1869).
Schraufite ? (Thomson, 1887).
Schrötterite (Dana, 1868).
Senarmontite (Davies, 1867).
Sericite.
Spangolite (Miers, 1893).
Spessartite (Heddle, 1878).
Stephanite (Davies, 1866).
Tallingite (Church, 1865).
Tavistockite (Church, 1865).
Thorite (Heddle, 1883).
Tobermorite (Heddle, 1880).
Totaigite (Heddle, 1878).
Tridymite (Lasaulx, 1876).
Turgite (Heddle, 1882).
Tyreeite (Heddle, 1881).
Uigite (Heddle, 1856).
Uralite.
Valentinite (Hall, 1868).
Vauquelinite (Davies, 1877).
Vermiculite (Parke, 1877).
Voltzite (Dana, 1868).
Walkerite (Heddle, 1880).
Waringtonite (Maskelyne, 1864).
Wicklowite (D'Achiardi, 1883).
Willemite (Glen & Young, 1876).
Wittichenite ? (Collins, 1871).
Woodwardite (Church, 1866).
Xantholite (Heddle, 1879).
Xanthosiderite (Haughton, 1866).
Xonotlite (Heddle, 1882).
Zeunerite (Weisbach, 1872).

V.—On Arborescent Carboniferous Limestone from near Bristol.[1] By Horace B. Woodward, F.R.S.

A SPECIMEN of Carboniferous Limestone showing arborescent markings was obtained by Mr. Spencer G. Perceval from Brentry Hill, near Henbury, Bristol, and was presented by him in 1897 to the Museum of Practical Geology. The rock is about six inches thick, and the lower half is a current-bedded oolitic limestone. The upper half comprises banded calcareous mud with a few layers of oolitic grains, and the material in this portion of the rock has been disturbed, the layers having been bent; while the hollows

[1] Read before Sect. C (Geology), British Association, Bristol Meeting, Sept. 1898.

between the curves are partially eroded and filled with irregular detrital material containing oolitic grains.

The surface of the block presents an irregular concretionary structure, resembling that seen on many varieties of Cotham Marble; but it is not so pronounced as in some of the mammillated surfaces seen in that rock.

The appearances are probably due to mechanical disarrangement of the upper layers produced prior to and during the consolidation of the rock, and they suggest a pause in the deposition of sediment.

It is noteworthy that the darker bands which produce the arborescent markings stand out slightly in relief on the weathered face of the block of Carboniferous Limestone. This is also the case with an example of Cotham Marble which I lately obtained on the South Wales Direct Railway at Stoke Gifford.

A small specimen of Carboniferous Limestone from Backwell, near Nailsea, given to me by Mr. W. H. Wickes, shows indications of arborescent markings. [Further references to the subject are given in the GEOL. MAG., Dec. III, Vol. IX, 1892, p. 110, and in "The Jurassic Rocks of Britain," Mem. Geol. Surv., vol. v, p. 230; see also B. Thompson, Quart. Journ. Geol. Soc., vol. L (1894), p. 393.]

VI.—THE BUILDING OF CLIFTON ROCKS. By E. WETHERED, F.G.S.[1]

IN this paper the author confines his remarks chiefly to the microscopic life which he has discovered in the Carboniferous Limestone rocks at Clifton. He contends that microscopic calcareous organisms have been the chief contributors to the vast deposits in the Carboniferous sea, now represented by the cliffs on either side of the gorge of the Avon at Clifton.

Broadly speaking, there were three stages in the formation of this limestone. These were regulated by physical conditions, and favoured the existence of certain forms of life. The fossil remains now denote the stages. They are as follows:—

	Approximate Thickness.
Stage 1. Lower Limestones (including the Lower Limestone shales, 500 feet, and Black Rock series, 470 feet)	990 feet.
Stage 2. Middle Limestone	1,620 ,,
Stage 3. Upper Limestone	100 ,,

The close of the Old Red Sandstone period is marked by variegated sandstones and shales. These beds pass into limestones and shales, and these again are followed by massive limestones locally known as the Black Rock; the whole representing the Lower Limestones, or Stage 1.

During this stage encrinites were so numerous in the waters that the ossicles of these creatures are a distinguishing feature of the limestones. Vast numbers of ostracoda at times lived, and some beds of the limestone are chiefly accumulations of the remains of these small crustaceans. Monticulipora corals and polyzoa were numerous in the waters, and also mollusca.

[1] Read before Sect. C (Geology), British Association, Bristol Meeting, Sept. 1898.

Another interesting feature, not before noticed in the Lower Limestones, is the mass of incrusting organisms. These organisms formed a crust around the fragmental remains of other bodies which collected on the sea-floor, and to such an extent did this process go on that the incrusting organisms contribute considerably to the building up of some beds of limestone. Whether these crusts are to be attributed to animal or vegetable growth is a matter of doubt.

The crinoidal life reached a climax during the time that the Black Rock Limestone was in process of formation. Indeed, this rock is, in the main, a vast accumulation of the ossicles of these "stone-lilies," associated with shells of mollusca, fish remains, etc.

The Black Rock series terminate in dolomitized limestone, and on this rest the 'Gully Oolites.'

The Lower Limestones terminate at these oolites, in which occur, though sparingly, foraminifera and the minute spherical object *Calcisphæra*. This latter body averages about ·012 of an inch in diameter, but, small as it is, the calcareous sphere has been an important contributor to the building of the rocks.

As *Calcisphæra* is confined to the Carboniferous Limestone, and is so numerous that it is seldom a thin section of the rock is obtained without finding it, the organism is useful in determining the strata when doubtful. So far, the author has not found *Calcisphæra* in the Lower Limestones, and the same remark applies to foraminifera.

Above the horizon of the Gully Oolite the lower beds of the Middle Limestone are characterized by the occurrence of the curious organism *Mitcheldeania*; but it is not confined to this horizon.

Next follow limestones and calcareous shales full of the remains of little understood forms of microscopic life, which must have existed in great profusion.

As before remarked, the Middle Limestones are characterized by foraminifera and *Calcisphæra*. At first these occur sparingly, but later on the rock is little more than a Carboniferous foraminiferal ooze. Remains of corals occur and other well-known fossils, but the bulk of the 1,600 feet of limestone included in the Middle Series is in the main a vast calcareous deposit of the remains of microscopic life which lived in the Carboniferous waters.

Owing to the Upper Limestones being so built over, the author is at present not in a position to describe the microscopic life which the strata probably contain associated with larger organisms.

VII.—On the probable Source of the Upper Felsitic Lava of Snowdon.[1] By J. R. Dakyns, M.A.

BETWEEN Glaslyn and Bwlch Goch, as the lowest part of the ridge between Crib Goch and the top of Crib y Ddysgl is called, a mass of felstone rises like a wall through the beds of the calcareous ashy series. The trend of the dyke is E.N.E. The best section is along the N.W. face, where the felstone is clearly seen standing as a wall against the truncated edges of the calcareous

[1] Read before Sect. C (Geology), British Association, Bristol Meeting, Sept. 1898.

ashy beds. The felstone shows *lines of flow parallel to its side*, and in some places is rudely columnar, *the axes of the prisms being perpendicular to the side of the dyke.* It is owing to this arrangement of the columns, and of the lines of flow, that I consider the rock to be a dyke. I call it a dyke because of the straightness of its sides; but it is rather a boss than a dyke, as, while it is two hundred yards wide, it is only about three or four hundred yards long. The rock is not like any of the lower Snowdonian felsites occurring in the immediate neighbourhood, but it is decidedly like the upper felstone, which forms outliers on Crib Goch and Crib y Ddysgl. It seems to me that we have here the source of the upper felsitic lava of the Snowdon district. The boss is a plug of rock consolidated in and filling up the orifice through which the upper lava flowed to the surface.

VIII.—On Worked Flints from Glacial Deposits of Cheshire and the Isle of Man.[1] By J. Lomas, A.R.C.S., F.G.S., Pres. Liverpool Geol. Soc.

FLINTS are not common in the glacial deposits of N.W. England. In one or two places in the Wirral, however, and in the Isle of Man, they are fairly plentiful. Sometimes they occur in the Boulder-clay, but more frequently in Glacial Sands and Gravels. Some of the flints collected in these localities show undoubted signs of human workmanship.

Prenton, Birkenhead.—The flints exhibited were collected from a recent excavation near Mount House. Soft Bunter is seen on the south and west faces overlain by glacial sands. Between the two lies a bed of gravel containing small Lake District and Scotch erratics up to six inches in diameter, along with broken Triassic rocks, clay galls, and marine shells. In this gravel most of the flints have been found. Others occur in the overlying sand, which also contains erratics and shell fragments. Similar sand occurs at many places in the immediate neighbourhood, and is usually overlain by Boulder-clay.

Spital Sandpit. — False-bedded clean sand is seen, containing gravel and rolled clay galls, overlain by tough Boulder-clay. The flints occur both in the gravel and Boulder-clay.

Capenhurst.—Flints collected from gravel bands and clay in old sandpit opposite church.

Mollington, near Chester.—The large sandpit, near high road, contains very little gravel, and the flints mostly occur in the Boulder-clay which caps the section.

Cliffs north of Ramsey, Isle of Man.—Glacial deposits in north of island well exposed in the fine cliffs which extend from Ramsey almost to the Point of Ayre. Near Ramsey, sands and gravels predominate, and these get successively more and more clayey towards the north.

In collecting the flints I took great care to separate those found in the talus slopes from those actually in the clays and gravels. The flints are exhibited and speak for themselves.

[1] Read before Sect. C (Geology), British Association, Bristol Meeting, Sept. 1898.

REVIEWS.

I.—Fossil Medusæ. By Charles Doolittle Walcott, F.G.S. Monographs of the United States Geological Survey, Vol. XXX. 4to; pp. 201, pls. 48, figures in text 26. (Washington, 1898.)

THE main interest and importance of this Monograph on Fossil Medusæ depend on the descriptions given of some peculiar bodies, regarded by Professor Walcott as casts of Discomedusæ, which occur in considerable numbers in shales, of Middle Cambrian age, in the Coosa Valley, Alabama. These bodies are found in intimate association with siliceous nodules, sometimes apparently constituting the entire nodule, at others in solid projecting relief on the outer surface, and also entirely enclosed and surrounded by the mineral constituents of the nodule.

The semi-cherty nodules, or star-cobbles as they have been termed, in allusion to their radiately lobed forms, which suggest a rude resemblance to starfishes or sea-urchins, occur as narrow bands in the finely laminated shales; and they weather out on the surface and in the drainage channels of the district in such abundance that 9,000 specimens were collected for study by the United States Geological Survey, but only about one-fourth of these show the presumed medusæ, and many seem to have been formed independently of the presence of any organisms. Other nodules, however, contain fragments of the characteristic fossils occurring in the shales, such as brachiopods, trilobites, and in a few instances casts of hexactinellid sponge spicules; the trilobite tests are now replaced by crystals of quartz. Further, the nodules are traversed in all directions by fine annelid borings, which penetrate the matrix and medusæ casts equally.

The medusoid nodules have been carefully examined microscopically and chemically. Professor Iddings reports that they consist of a mixture of granular quartz in allotriomorphic grains, occasional flakes of muscovite mica, and a small amount of calcite, gas pores, and colouring matter, probably carbonaceous. Dr. Hayes states that thin sections under low microscopic powers show a close resemblance to ordinary cherts. They have a finely mottled-grey appearance in polarized light, the extinction being similar to that of cryptocrystalline or chalcedonic silica. The chief differences between the nodules and ordinary chert, when seen under a magnification of 100 diameters, are the presence in the former of mica flakes, in more or less abundance, and the absence of rhombohedral cavities, usually found in the chert concretions formed in a calcareous matrix. But under a power of 400 diameters Dr. Hayes found a marked distinction between the nodules and chert; the former seemed to be almost wholly composed of two kinds of extremely fine grains with sharply defined outlines. One kind is original detrital quartz, the other a hydrous silicate of alumina or clay. If amorphous silica

be present at all, it is inconsiderable in amount. No concentric structure is to be seen in the nodules, but some show lamination marked by parallel mica scales, as if the nodule were produced by a silicification of a portion of the stratified mud or shale. A chemical analysis of a portion of a nodule within the body of a medusa showed 88·33 per cent. of silica, nearly 4 per cent. of calcite, and 4 per cent. of alumina; whilst the shale in which the nodules are imbedded consists of 55 per cent. of silica, 21 per cent. alumina, and under 2 per cent. calcite.

The bodies described as silicified medusæ are very varied in form; so much is this the case that it is difficult to find any two alike. Those placed under the genus *Brooksella* are for the most part discoidal or cake-shaped bodies from 1 to 5 cm. in diameter, with a depressed convex upper surface, consisting of a number of lobate arms or rays extending from a common rounded central area. These lobes are considered to be the umbrella of the jelly-fish; there are from six to more than twenty of them in different individuals; some are narrow, subcylindrical, and terminate obtusely, whilst others are expanded or club-shaped distally. On the under surface of these bodies there is another series of arms, proceeding, like those of the upper surface, from the central area or axis, which are regarded as the lobes of the sub-umbrella; and, further, in some specimens, between the upper and under series, there is yet another set of lobes, attached to the central axis, belonging to the inter-umbrella. This peculiar combination of lobate arms "results in a very complex structure, and instead of a simple symmetrical medusa, an irregularly lobed body results, with round appendage-like lobes projecting out in various directions from the central disk or axis." In each lobate arm of these different series a simple radial canal extended, and opened into the central axis which is believed to represent the central stomach of the organism. Judging from the figures, these radial canals are often shown as small circular openings at the distal extremity of the lobes, or, when exposed in section, as narrow infilled tubes of a different coloration in their axial line, and they are very similar in appearance to the canals of fossil sponges when infilled with silica. No trace of an oral opening has been noticed in these bodies, and in only one specimen an oral plate, formed by the union of four arms at the centre, has been recognized. Tentacles are unknown.

In a second genus, *Laotira*, there is a still more complex development of lobate arms, and in some compound forms three radiate centres appear to be present, and the lobate arms from each intercommunicate with one another.

Assuming that these peculiar bodies are fossil medusæ, the question naturally arises as to the mode in which they can have been preserved, so that not only the numerous lobate arms and appendages, but even the axial canals within them, retain their original form as solid casts in silica. The author fully recognizes that, according to present opinion, such delicate organisms can only have been preserved as fossils by faint impressions in fine calcareous

mud, sandstone, or shale; but he is very firmly convinced that these silicified bodies are the casts of medusæ, and explains their present condition by supposing that, like the recent *Polyclonia frondosa* of the West Indian seas, the organism lived on a muddy bottom, with the dorsal surface of the umbrella—disk downwards and the tentacles turned upwards; and thus, under favourable conditions of burial by a rapid deposition of sediment, the watery contents of the medusa would be sufficiently retained so as to avoid a collapse, whilst the sediment penetrated into the interior and had time to harden. In the case of forms showing the canals the author considers "that these and the other internal cavities of the organism were filled at once, to a greater or less extent, by the soft siliceous ooze or mud. As the animal matter decomposed, the ooze gradually took its place, and then began the silicification of the sediment that resulted in the formation of the cast of the medusa, and of the nodules by the extension of the silicification into the surrounding sediment."

These "silicified medusæ" are so fully described and illustrated in the monograph that palæontologists will be enabled to form their own opinion upon them. Many of this sceptical race, particularly those who have picked their way on a sandy shore strewn over with the unsubstantial bodies of jelly-fishes, will probably hesitate in accepting these solid forms as medusæ. The author states that he has considered the alternative question whether these peculiar bodies may not have been siliceous sponges, but the absence of spicules in a large number of microscopic sections examined, and the fact that some of the forms occur as compressed films in the shale, led him to reject this view of their origin.

In the same family with the Middle Cambrian forms, Professor Walcott also places the *Dactyloidites asteroides*, Fitch, sp., which occurs as dark stains in the slates of Lower Cambrian age in Eastern New York. This fossil was originally described as a marine alga, but the author regards it as the body of a medusan flattened in the slate, and not the cast of the interior.

With respect to the fossil medusæ from the Lower Cambrian of Sweden, we think that the impression of *Medusites Lindströmi* figured by Dr. Nathorst in "Sveriges Geologi" and reproduced in this monograph, fully establishes the existence of medusæ on this horizon.

Following the description of the Palæozoic medusæ, the author refers to those from the Jurassic strata of Bavaria, and then notices those reported to occur in flint nodules from the Chalk of Europe. A collection of these latter from the Natural History Museum of Hamburg proved on examination to belong to sponges, as had indeed been suspected by Dr. Gottsche, and not improbably other reputed medusæ in flint will be found to have a similar origin.

The admirable series of plates which accompanies and illustrates the text of Mr. Walcott's Monograph greatly facilitates the understanding of the author's views in regard to the remarkable bodies he has so minutely and carefully described. G. J. H.

II.—The Principles of Stratigraphical Geology. By J. E. Marr, M.A., F.R.S. 8vo; pp. 304. (Cambridge: at the University Press. Price 6*s*.)

THE object of the present work is to give "some idea of the methods and scope of Stratigraphical Geology"; and the task of the Stratigraphical Geologist, as the author clearly states it, is "to record the events which have occurred during the existence of the earth in the order in which they have taken place." The subject is confined within tolerably strict limits, and it is treated solely in its scientific aspect: we have no digressions on the form of the ground, and no references to the economic applications of stratigraphical knowledge. The nature of stratified rocks, the means by which the order of succession is established, the method of formation of the strata, the general conditions of each period, and the correlation of the groups of strata, are the chief matters discussed; and they are introduced in orderly succession after a short account of the growth and progress of stratigraphical geology.

The Cambridge School has acquired a deserved name for cautionary teaching, and the author very fully places before his readers many considerations that should be weighed before coming to definite conclusions. In a useful chapter on "Simulation of Structures," he draws special attention to pseudo-organisms, false ripple-marks, diverse parallel structures, and crush-conglomerates or (as he prefers to call them) fault-conglomerates; and when the student comes to deal with our stratified formations, with classification and correlation, he will find more than enough of vexed questions over which to ponder.

One of the earliest of geological lessons is that all kinds of sediment are being laid down in various aqueous areas, from coarse detritus to deep-sea ooze, and that at the present day there is a gradual change in the character of the fauna which exists at various depths and at varying distances from the sea-margins. When we come to the stratified formations which constitute the bulk of the land on which we live, we learn that in those typical localities which first gave name to the formations only limited portions of the sea-bed of the period can there be represented. Such names as Wenlock Shale, Inferior Oolite, Oxford Clay, Lower Greensand, and London Clay indicate the lithological character of formations at so-called typical localities. Subsequent study has shown the presence on the same general horizon of strata of quite different lithological characters, and different local subdivisions with local names have come to be applied, such as the Denbighshire Grits, the Lincolnshire Limestone and Northampton Sands, the Spilsby Sandstone, Tealby Clay, etc. From such local phenomena the geologist may seek to push his inquiries into the wide world and study the general sequence of events, and he then requires chronological terms of broad significance.

It is now that the student has to face many and difficult problems which are fairly and as fully as possible stated by the author. While each great group of strata has a series of characteristic fossils,

their distribution in time and space varies greatly in most cases. We have to bear in mind that the organic remains to be found in limestones, clays, and sands of the same age will differ in a marked degree. Nevertheless, there are to be found certain widely diffused forms—trilobites, graptolites, brachiopods, belemnites, ammonites, and others—which serve to act as indices of age. Species of some of these fossils have been found to occur in definite sequence, as definite as the sequence of strata, but irrespective of the kinds of sediment. Consequently there have been established certain 'zones' which are characterized either by one or more particular species or by assemblages of fossils. They are clearly palæontological horizons, for they are not lithological divisions of the strata. In a conformable series no one knows the precise limits of range of any one species. In useful diagrams given by the author (p. 62), he shows how each species may have a varied range in time in a formation or series of strata. No doubt each species has its definite chronological and geographical limits, although we can never know exactly what these are. The author remarks that, "strictly speaking, the term zone (a belt or girdle), when applied to distribution of fossils, should refer to the belt of strata through which a fossil or group of fossils ranges." We do not quite agree with the author in this definition. Zones of course must be identified by fossils and not by the strata; and therefore they serve to indicate periods of time rather than masses of sediment. We could hardly speak of a zone which is represented partly in Upper Greensand, partly in Red Chalk, and partly in Gault Clay as forming a belt of strata. A zone may be represented, as the author points out, in strata 8 inches thick or 5,000 feet thick; but the true belts of strata are such as he well represents in his diagram, p. 175, and we wish he had given more of these stratigraphical figures.

The author devotes a brief chapter to geological maps and sections, and points out the great advantage of drawing longitudinal sections to a true scale. In addition to the ordinary geological maps which depict the stony structure of the country, he would like to have also a set of chronological maps founded on the sequence of fossil organisms. We wonder who could construct such zonal maps. It is possible that over small areas, by aid of numerous excavations and long-continued fossil-collecting, something might be done to indicate in a rough way the palæontological divisions. We should like the author to map (irrespective of any lithological aid) the Upper Cretaceous subdivisions—the Albian, Cenomanian, Turonian, and Senonian, to use the chronological terms which are sometimes employed. We doubt, indeed, if any field-geologist would find these terms so useful on the ground in this country as Gault and Upper Greensand, Lower, Middle, and Upper Chalk.

The author very properly points out that "The establishment of a classification on palæontological lines by no means does away with the necessity for local classifications on a lithological basis." Each country is apt to frame its local classification on stratigraphical and lithological grounds, hence when local terms from other

countries are introduced their true meaning is altered and confusion arises. Such has been the case with terms like Cenomanian, Portlandian, Kimeridgian, and Callovian. The term Portlandian should only be used for the period represented by the Portland Beds of Portland, the Callovian for the period represented by the Kellaways Beds of Kellaways, and so on.

The student who peruses Mr. Marr's handy book will be prepared to encounter numerous difficulties, but his path will have been smoothed by the many useful explanations and suggestions, and he will be prepared to weigh the possibilities and probabilities before coming to definite conclusions. After all, the chief difficulties which beset the student are not in the folds and overthrust faults which locally interfere with the true sequence, nor in the determination of the method of origin of the strata, nor even in the correlation of formations when the organic remains have been carefully studied and determined. The greatest difficulties are in the identification of species amid the "tangled mazes of the synonymy"; and the best chance of doing good work in stratigraphical geology is to specialize on formations and faunas, aiding local research by a study of what has been done in other parts of the world. To endeavour to do a little well must be the aim of all students, and Mr. Marr's work will surely aid the enthusiastic inquirer in dealing with the many problems which come before him.

III.—Outlines of the Earth's History: A Popular Study in Physiography. By N. S. Shaler, Professor of Geology in Harvard University. 8vo; pp. iv, 417, with 10 full-page Illustrations and 23 Figures in the text. (London: W. Heinemann, 1898.)

THE object of this book, as stated in the preface, "is to provide the beginner in the study of the earth's history with a general account of those actions which can be readily understood, and which will afford him clear understandings as to the nature of the processes which have made this and other celestial spheres." The treatment of this widely embracing, one might almost say boundless, subject is brought within the compass of nine chapters, the titles of which will give a clue to their contents. The first is an introduction to the study of Nature, followed by a somewhat abstrusely historical, rather than practical, account of the ways and means of studying it. The succeeding chapters are on the Stellar Realm; the Earth; the Atmosphere; Glaciers; the Work of Underground Water; the Soil; and lastly, the Rocks and their Order. Under these heads very good descriptions are given of the most important natural phenomena, and they are principally illustrated by examples to be found in North America, which, though less likely to be familiar to students in this country, are oftentimes of a more striking and representative character than instances drawn from more limited areas. To some of the statements given exceptions might be made; for example, that the floors of the deeper seas are plentifully scattered

over with volcanic cones! A novel explanation of the origin of the clayey partings or division planes in limestones is, that they arise from the action of earthquakes which result in shaking up the fine silt of the bottom of the ocean and produce a mud which is fatal to the breathing organs of the animals living on the sea-floor, and consequently the materials of these shaly layers are mostly inorganic!

Though Professor Shaler's work is, perhaps, more especially adapted for the scientific public of the United States, it nevertheless contains much that deserves the attention and consideration of geological students generally.

IV.—A Student's Textbook.

An Intermediate Textbook of Geology. By Professor Charles Lapworth, F.R.S. Founded on the "Introductory Textbook of Geology" by the late David Page. pp. 414, with 174 Illustrations. (London: William Blackwood & Sons, 1899.)

ENGLISH teachers of Geology are to be congratulated upon the issue of a new edition of Professor Lapworth's revision of Page's "Introductory Textbook." The book is an even greater improvement on the 12th edition than that was on its predecessors. The new issue is better illustrated; some unfortunate misprints and errors which slipped into the pages of the 1888 edition have been removed; the palæontological nomenclature is more modern; and the book is so much larger that it well deserves its new title of an "Intermediate Textbook of Geology." The work as it now stands is essentially a British student's textbook, and for students after their first year's course it seems to us quite indispensable.

The most remarkable feature in the book is that it is crowded but clear. The information is very condensed, but the main outlines are graphic. Professor Lapworth shows his unusual power of making every subject appear real with detail, while the main idea stands out with the clearness of a diagram.

The account of British geology is illustrated by a series of new and lucid maps, each showing the range of one system and the areas of early and later formations. The stratigraphical section is naturally the best, and is well up to date. Regarding it we have only one regret, Professor Lapworth's systematic self-suppression. One naturally expects to learn his opinion on disputed questions; and as a rule one has to read between the lines. For the author is careful not to encourage students to abandon orthodox beliefs too readily, and his own opinions have to be guessed from the insertion of such reserving clauses as "have been regarded," "is supposed to have been," or "it is held by some." Most geologists would probably have preferred the book to have definitely told us what Professor Lapworth himself regards, supposes, or holds in reference to the main disputed problems.

A feature in the new edition which is especially worthy of notice is the series of masterly sketches of foreign geology; they are

short and up-to-date, and always bring out the most important points. It is perhaps a pity to have left in the old and probably mythical idea of the tropical condition of Greenland in Miocene times.

The palæontological summaries are illustrated by many figures, of which the new ones are of unusual clearness and softness. The legends of the old blocks might have been further revised; for instance, the fossil numbered 3 on p. 339 is certainly not even a member of the genus to which it is referred. It is possibly not an oversight that has led the author to record a common Silurian starfish as a *Protaster*, although it was made the type of a new genus and family, *Lapworthura* and Lapworthuridæ. A misconception regarding the London Clay bird *Odontopteryx* may be noticed, as it is widespread: the bird is described as "dentigerous or toothed"; the latter term is not absolutely incorrect, as it is not unusual to speak of prominences on a beak as teeth, but "dentigerous" certainly suggests that the bird had true teeth like the American Odontornithes. But the errors of this sort are comparatively trivial, and a certain number is inevitable in a book so full of information. The new textbook may be confidently recommended to teachers for the clearness of its statement of leading principles, the terseness of its summaries of facts, and its graphic sketch of British geology.

REPORTS AND PROCEEDINGS.

Geological Society of London.

I.—December 21, 1898.—W. Whitaker, B.A., F.R.S., President, in the Chair.

The President announced that Mr. F. W. Harmer, F.G.S., had most generously offered to the Society the manuscript maps of the Drift of the Eastern Counties made by the late Mr. Searles Wood, jun., and by himself. The Council, in accepting the maps, had passed a resolution specially thanking Mr. Harmer for the gift, and the Fellows were now asked to add their thanks to those of the Council.

The following communications were read:—

1. "On a Megalosauroid Jaw from Rhætic Beds near Bridgend, Glamorganshire." By E. T. Newton, Esq., F.R.S., F.G.S. (Communicated by permission of the Director-General of H.M. Geological Survey.)

The specimen which forms the subject of the present communication was obtained from Mr. John David of Porthcawl, from a mason, and it has been presented to the Museum of Practical Geology. It was derived from beds low down in the Rhætic Series, which may eventually have to be included in the upper part of the Keuper. The lamellibranchs on the same slab appear to be *Pullastra arenicola* and possibly *Myophoria*. The specimen has been compared with reptilian jaws in the British Museum; it consists of a mould of the

dentary bone with several teeth in place. The impression of the whole of the inner surface and of the anterior half of the outer surface is preserved. The front half of the inner surface of the jaw is like that of *Megalosaurus*, except in size. Many of the teeth are seen in various stages of projection from their sockets, and the points of two successional teeth may also be seen, and thus the mode of succession of the teeth may be clearly understood. The specimen does not admit of exact comparison with *Megalosaurus*, and it is named as a new species of *Zanclodon*—a genus in which the author is also inclined to place some forms described under the names of *Palæosaurus*, *Cladyodon*, *Avalonia*, and *Picrodon*.

2. "The Torsion-Structure of the Dolomites." By Maria M. Ogilvie, D.Sc. [Mrs. Gordon]. (Communicated by Professor W. W. Watts, M.A., Sec. G.S.)

The paper opens with a general account of the work of Richthofen, Mojsisovics, Rothpletz, Salomon, Brögger, the author, and others on the Dolomitic area of Southern Tyrol. It then gives the results of a detailed survey recently made by the author of the complicated stratigraphy of the rocks of the Gröden Pass, the Buchenstein Valley, and the massives of Sella and Sett Sass; together with the author's interpretation of these results, and her application of that interpretation to the explanation of the Dolomite region in general. The author concludes that overthrusts and faults of all types are far more common in the Dolomites than has hitherto been supposed. The arrangement of these faults is typically a torsion-phenomenon, the result of the superposition of a later upon an earlier strike. This later crust-movement was of Middle Tertiary age, and one with the movement which gave origin to the well-known Judicarian-Asta phenomena. The youngest dykes (and also the granite-masses) are of Middle Tertiary age, while the geographical position of both is the natural effect of the crust-torsion itself. This crust-torsion also fully explains the peculiar stratigraphical phenomena in the Dolomite region, such as the present isolation of the mountain-massives of Dolomitic rock.

The Gröden Pass area, first selected for description by the author, is a distorted anticlinal form running approximately N.N.E. and S.S.W., and including all the formations ranging from the *Bellerophon*-Limestone, through the Alpine Muschelkalk and Buchenstein Beds, to the top of the Wengen Series. When studied in section, the strata of the Pass are found to be arranged in a complex fold form, showing a central anticlinal with lateral wings, limited on opposite sides by faults and flexures. Strongly marked overthrusting to S.S.E in the northern wing is responded to by return overthrusts to N.N.W. in the southern wing. The strata in the middle limb of the anticlinal wings bend steeply downwards into knee-bend flexures. Through these run series of normal and reversed faults, into which has been injected a network of igneous rocks, giving rise to 'shear-and-contact' breccias, which have previously been grouped as Buchenstein tuff and agglomerates, and referred to the Triassic period.

The area of movement of the Gröden Pass system is an ellipsoid in form. Two foci occur within it, where the effects of shear and strain have culminated. The forces of compression acted not in parallel lines, but round the area, thus causing torsion of the earth-crust. Two main faults occur (with a general east-and-west trend) whose actual lines of direction intersect at a point about midway between the foci of the torsion-ellipsoid. These are the chief strike torsion-faults; many minor ones pass out easterly and westerly from the foci, forming longitudinal or strike torsion-bundles. The strike system of faults is cut by a series of diagonal or transverse curved branching faults, with a more or less north-easterly or north-westerly direction. These diagonal faults may cut each other, or may combine to form characteristic torsion-curves. The author regards the longitudinal and diagonal faults as constituting one system. Each portion on one side of the anticlinal form of the system has its reciprocal on the other side. The Spitz Kofl syncline on the north is the reciprocal of that of Sella on the south, the Langkofl on the south-west of that of Sass Songe on the north-east, and so on.

The anticlinal area of the Buchenstein Valley is next described. Here we have a torsion-system similar to that of the Gröden Pass, and made up of similar elements; but the western portion of the anticlinal is much compressed and displaced. Opposing areas of depression are also found here, that of Sella and Sett Sass on the north being reciprocated by that of the Marmolata on the south, and so on. The porphyrite-sills have here been mainly injected into the knee-bends of the northern wing of the anticlinal form, but igneous injections and contact-phenomena are also met with in some of the transverse faults.

A full description is given of the sequence and stratigraphy in the Sella massive—once regarded by some authorities as a Triassic coral-reef. This is an ellipsoidal synclinal area with N.N.E. and S.S.W. axes twisted to north-east and south-west. Peripheral overthrusts have taken place outward from the massive, in such a way as to buckle up the rocks like a broad-topped fan-structure, and these overthrusts are traced by the author completely round the massive. A central infold of Jurassic strata occurs on the plateau, where the Upper Trias has been overthrust inwards on three sides of the infold. The author next passes in review the results obtained in the areas of Sett Sass, etc., and shows how they all present corresponding tectonic phenomena.

The district thus studied in detail by the author forms a typical unit in the structural features of the Dolomite region. It is cut off to the eastward by the limiting fault (north-and-south) of Sasso de Stria, and to the westward by the parallel fault of Sella Joch. These are definite confines, which limit a four-sided area, influenced by the Gröden Pass torsion-system on the north and the Buchenstein Valley system on the south. The limits of this four-sided figure include a compound area of depression (formed by the Sella and Sett Sass synclinals) traversed by the diagonal Campolungo buckle.

"The area displays in a marked degree the phenomena of interference cross-faults cutting a series of peripheral overthrusts round the synclines, and parallel flexure-faults between the anticlinal buckles and the synclinal axes."

In conclusion, the author applies her results to the interpretation of the complexities of the Judicarian-Asta region of the Dolomites in general, and also to the explanation of the characteristic structural forms of the Alpine system as a whole.

II.—January 4, 1899.—W. Whitaker, B.A., F.R.S., President, in the Chair.

Captain A. W. Stiffe, in exhibiting a fossil *Cardium* (?) from the beach at the foot of the cliffs of Ormara (Makran Coast), made the following remarks:—"The specimen on the table has been kindly lent to me by Mr. Ffinch, Director of the Government Indo-European Telegraphs. The peninsula of Ormara, whence the shell comes, is composed of a mass of flat-topped hills about 10 miles in length; it is about 1,200 feet high at its western end, sloping down to about 400 feet at its eastern end—flat on the top, and ending on all sides in cliffs. The rocks are chiefly clay, with a thin conformable capping of shelly breccia 20 to 50 feet thick. The fossils in the clay are difficult to find, and probably are generally enclosed in nodules of the clay somewhat altered, as in this specimen. The fossil now exhibited was picked up on the sandy beach near the foot of the cliffs, which are naturally undergoing rapid denudation. In a paper read by me before this Society in 1874, the formation was considered to be of Miocene age by Mr. Etheridge. I should be glad to learn whether this fossil supports that view of the age. Nearly all the coast in question for many hundreds of miles is of similar formation; the strata are as a rule slightly inclined only and of fantastic outline."

The following communications were read:—

1. "Geology of the Ashbourne and Buxton Branch of the London and North-Western Railway.—Ashbourne to Crake Low." By H. Arnold-Bemrose, Esq., M.A., F.G.S.

The southern part of the new railway from Ashbourne, through Tissington and Crake Low, to Buxton exhibits several sections in Trias, Boulder-clay, Mountain Limestone, and Yoredale Beds. Interstratified with the latter is a thick bed of volcanic ash, with thinner intercalations of tuff. Within a mile of Tissington ash is exhibited four times in the cuttings, and according to the view of the author it is the same bed repeated by basins and domes, one of the latter of which is faulted. While the rocks succeeding the ash in some places are limestones, cherts, and shales of Yoredale type, in one section they resemble more closely the upper beds of the Mountain Limestone. The limestones are often dolomitized. The ash-bed is 144 feet thick where fully exposed; it is stratified, the beds varying in texture, and the lapilli in them range from

microscopic dimensions to 1 inch in diameter. The lapilli are glassy or palagonitic; but felspar-microlites are rare, and the rock of which they are made has no counterpart among the lavas of the county. The ejected blocks in the ash vary from several inches up to 1 foot in diameter, and are similar to the blocks in the vent at Kniveton. The small lapilli scattered through the limestones are generally converted into calcite or dolomite with oxide of iron. The paper was illustrated by microscopic slides, and horizontal and vertical sections of the cuttings and quarries described; also by hand-specimens, photographs, and lantern-slides.

2. "The Oceanic Deposits of Trinidad." By Prof. J. B. Harrison, M.A., F.G.S., and A. J. Jukes-Browne, Esq., B.A., F.G.S.

"The object of this communication is to present some observations on the succession and geological relations of the beds which have long been known in Trinidad as the Naparima Marls. This name was given by Messrs. Wall & Sawkins in 1860, on account of their occupying a large part of the Naparima district east and south-east of San Fernando. The beds so named formed one of the five series which were described by these authors under the head of the Newer Parian Group." In his historical introduction Mr. Jukes-Browne deals with the writings of Mr. Guppy and Professor Harrison, and shows that three definite issues are thus raised:—(1) Are the Nariva Beds above or below the Naparima Marls? (2) Do the *Globigerina*-marls occur in the Naparima district, and, if so, are they connected with the Radiolarian marls or are they part of a separate formation? (3) What is the relation between the San Fernando Beds and the other groups? Mr. Guppy and Professor Harrison agree in answering the first part of the second question in the affirmative, and in stating that the two marls are closely connected together.

In the second part of the paper Professor Harrison tabulates the following succession in the Naparima district:—

3. Radiolarian beds resembling those of Barbados.	Oceanic Series.
2. Grey *Globigerina*-marls, the same as those of the coast-section.	
1. Red and blue clays.	Nariva Beds.

Although junctions of the Nariva Beds and the Oceanic Series are not seen, at Ste. Madeleine Usine the clays of the former series occur 30 feet lower than the *Globigerina*-marls, and there appears to be no transition between the two series. On the other hand, the transition between (2) and (3) appears to be complete. A comparison with the corresponding beds at Barbados now becomes possible, and this shows that the *Globigerina*-marls occupy the place of the basal chalks of Barbados, but are much thicker, while the radiolarian rocks are thinner, and the interbedded volcanic ashes so frequent in Barbados are wanting in Trinidad. Chemical and microscopic analyses of the *Globigerina* and radiolarian beds are given, and, compared with similar analyses of the Barbadian deposits, they show that more quartz and argillaceous matter occur in Trinidad. The radiolarian marls contain iridescent scales due to

fragments of the frustules of the diatom *Ethmodiscus*, which is "quite characteristic of some of the deepest tropical red clays and radiolarian oozes far from land." The 'argiline' beds appear to be formed from the alteration of the lower *Globigerina*-marls. The following correlation is proposed:—

Barbados.		Trinidad.	
Coral Rocks, Bissex Beds	... ...	Moruga Series ...	*Pleistocene and Pliocene.*
Oceanic Beds ...	... ...	Naparima Marls ...	*Miocene.*
Scotland Beds	Upper ...	San Fernando Beds	*Oligocene and Pliocene.*
	Lower ...	Nariva Series	

The Oligocene and Eocene beds are of shallow-water origin, and seem to be unconformably covered by the Naparima Marls.

CORRESPONDENCE.

CRYSTALS FROM DECOMPOSED TRAP.

Sir,—Early in the year, in examining some refuse-heaps near Dreghorn, Ayrshire, I found a few crystals which had been weathered out from a decomposed trap. The altered rock is white, and on exposure has fallen into dust, leaving the crystals isolated and perfectly sharp. In some places the rock is particularly white, and the crystals themselves have been reduced to powder. Much of the trap is a hard solid rock, with large conspicuous aggregates of enclosed crystals; every variety from the solid rock to the altered 'white horse' (a local name of white trap) can be obtained. I am informed by Mr. L. J. Spencer, of the British Museum (Natural History), that the isolated crystals are really pseudomorphs of serpentine after augite.

J. Smith.

Monkredding, Kilwinning.
December 15, 1898.

FORAMINIFERAL FLINT FROM SOMALI.

Sir,—The Rev. R. Ashington Bullen, F.G.S., lately lent me some stone implements (labelled as having been collected by Mr. Seton-Karr in Somali, Eastern Africa), for exhibition before the Anthropological Institute, in illustration of my paper on large African stone implements (see Journ. Anthrop. Institute, new series, vol. i, 1898, p. 48). Some of these Somali implements are composed of quartzite, rather ferruginous, gritty, and hard, though the grains are only cemented at their peripheries, and not closely compact; others are of flint, coarse-grained by the visible presence of the minute organisms originally constituting the limestone of which the flint is a more or less perfect pseudomorph, still to a great degree calcareous. Many microzoa, chiefly internal casts of Foraminifera, stand out on the roughly weathered surface, and numerous sections of these organisms are seen in the fractured stone. Some friends have examined the specimens with me, and although at first I suspected small Nummulites to be present, we

cannot find any certain evidence of them. Mr. Frederick Chapman, A.L.S., favours me with the following list of Foraminifera, which he has determined on the weathered surface of the flint on one of the Somali implements:—

Operculina, sp. with rib-like septa, common.
Heterostegina depressa, D'Orbigny, a very good specimen.
Cristellaria, two species, frequent.
Pulvinulina, one specimen.

I agree with Mr. Chapman in regarding the rock as being probably of Miocene or Pliocene age. T. Rupert Jones.

NOTE ON *DINOCYSTIS BARROISI*.

Sir,—Please allow me a few words in reply to the valuable paper of Mr. F. A. Bather on *Dinocystis Barroisi*.[1] In his paper "Sur l'étage devonien des psammites du Condroz en Condroz" (Bull. Acad. des Sci. de Belg., 1875, 2e sér., t. xxxix, pp. 658–9), Mr. M. Mourlon mentions, from Mr. Malaise's collection, an "astérie" found near Walcourt in an indeterminate "assise" of the "psammites du Condroz." This fossil is no longer quoted in the list of the fossils of this series, given by the same author in his "Géologie de la Belgique," but it is replaced (t. ii, p. 23) by *Agelacrinus*, very rare, in the "assises" of Montford and Évieux, the two *upper* assises of our Psammites du Condroz, and this is supposed by Mr. Bather to be the same as his *Dinocystis Barroisi*. Now the "astérie" of 1875 is the species found by Mr. L. Bayet, and described by me in my "Fragments paléontologiques" (Ann. Soc. géol. de Belg., 1881, t. viii, Mém., pp. 52–54, pl. iii, figs. 1 et 2), under the name of *Protaster Decheni*, and for important reasons I believe that the *Agelacrinus* of 1881 is the same species. Recently, I have learned from Mr. L. Bayet that his fossil was found in the "assise d'Évieux." G. Dewalque.

Liège, *January* 9, 1899.

THE SUBMERGED PLATFORM OF WESTERN EUROPE.

Sir,—In your January issue Dr. J. W. Spencer takes up the cudgels for Professor Hull on this subject, and treats your readers to a display of quarter-staff argument, by which he seems to hit me very hard, but is really cudgelling figments of his own too fervid imagination, fabrics which have far less substance than the windmills on which the renowned Don Quixote exercised his arms.

Dr. Spencer's communication may, indeed, be described as consisting in part of a discussion of points which I did not call in question and in part of denials of statements which were never made.

He says first that I denied the great subsidence of the continental margins, and a few lines lower (p. 18) that I denied their recent

[1] See Geol. Mag., Dec. IV, Vol. V, December, 1898, p. 543.

elevation. By referring to my letters published in September and November last your readers can see for themselves whether these statements are true or false. Dr. Spencer must have read my remarks so hastily that he failed to understand the drift of my argument, and perhaps when he succeeds in realizing that I did not anywhere deny either the subsidence or elevation of the continental margins he will have the courtesy to acknowledge that he has done me an injustice.

He accuses me of "turning the correspondence into an academic disputation of the meaning of the word 'escarpment,'" and into a "flat denial of the evidence submitted by Professor Hull." I hope to show that I did neither of these things.

Ever since Mr. Whitaker carefully distinguished between the features presented by a steep slope fashioned entirely by subaerial agencies and those of a raised sea-margin or cliff,[1] English geologists have restricted the term escarpment to the former, and have thought that the primary origin of the slope was a point of some importance. Dr. Spencer tells us that by American geologists the descent from a tableland or plateau is termed an escarpment, and he implies that they do not trouble themselves to ask whether the course of the feature was determined by the sea or by subaerial agencies. Of course Dr. Spencer ought to know, and I can only express surprise at what he says is American usage.

Again, Dr. Spencer asserts that I flatly denied Professor Hull's evidence. Now most people reading such a statement would suppose that I had flatly contradicted Professor Hull on statements of fact, which is very far from being the truth. Hence I am led to ask whether Dr. Spencer has any clear conception of the difference between evidence and inference.

I could wish that Professor Hull had displayed his facts more fully by reproducing some of the actual charted records, but I did not question the accuracy of his observations, nor his inference that the submerged plateau was once a land-surface and that traces of river-valleys may be found upon it. It was not his evidence but his further and more theoretical inferences that I questioned.

What I denied, and still deny, is that Professor Hull adduced any evidence to prove that the steep declivity which forms the border of the plateau was an escarpment in the English sense of the term, in other words that it has been formed and fashioned *entirely* by subaerial agencies. Not only did Professor Hull assume that it was so formed, but he further assumed, without proof and without consideration of other possibilities, that the platform was formed first and the declivity afterwards. Further, he referred these events to definite periods of geological time. I asked him to give his reasons for these conclusions, but in his reply (October) he did not answer the two latter questions (promising, however, to discuss one of them later on), and confined himself to defending his use of the term escarpment. Is it surprising that my rejoinder was similarly

[1] Geological Magazine, Vol. IV, pp. 447 and 483 (1867).

limited? and is Dr. Spencer justified in saying that I converted the correspondence into an academic disputation?

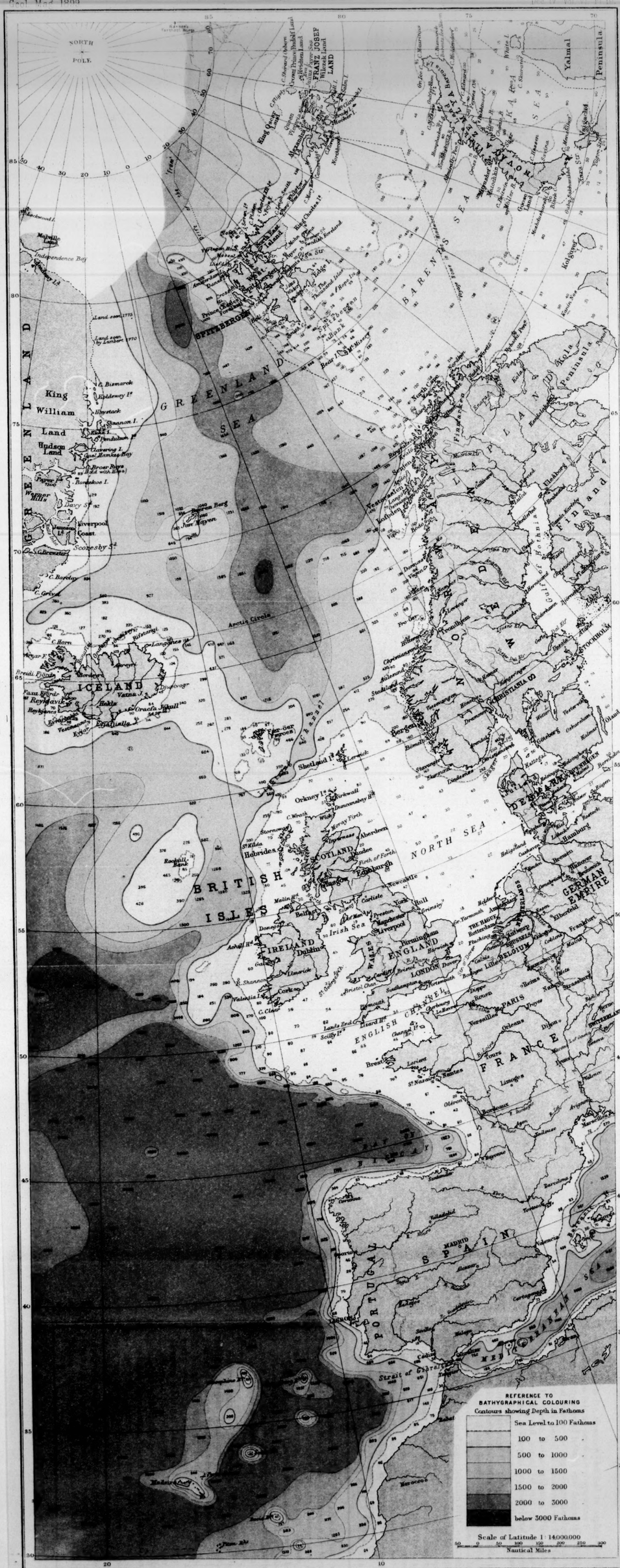
Because in my second letter I still denied that Professor Hull had given any good reason for regarding the declivity as a feature of subaerial origin, this denial is construed by Dr. Spencer into a flat denial of all Professor Hull's evidence. His desire apparently is that Professor Hull and himself should pose as martyrs for a new faith, and he hurls a defiance at any individual, council, or president of any learned society in the universe who should venture to doubt or deny his interpretation of the facts!

So long as Dr. Spencer maintains such an attitude it is impossible to argue with him. I am deeply interested in the history of this submerged portion of the European continent, and I look forward to Professor Hull's promised consideration of it, when he will doubtless answer my questions, for he is always a courteous opponent.

I have supposed that the position of the great declivity and its general course were determined by marine erosion (just as the present coastline has been), and, further, that the platform between the modern and the ancient coastlines was formed subsequently at the expense of the ancient continent. Both platform and declivity may have been afterwards modified by subaerial agencies, and this may have been the penultimate phase in their history, but this order of events is not that indicated by Professor Hull. A. J. Jukes-Browne.

William Colchester, J.P., F.G.S. This well-known geologist, so long connected as Chairman with Messrs. Lawes' Chemical Manure Company, of the Manganese Bronze and Brass Company, and Senior Partner in Messrs. Colchester and Ball's Chemical Manure Manufactory, who had attained to the advanced age of 85 years, died at his residence, Burwell Hall, Cambridgeshire, on the 16th November, 1898. We shall give an obituary of Mr. Colchester in our March Number.

Henry Alleyne Nicholson, M.D., D.Sc., Ph.D., F.R.S., F.G.S., Regius Professor of Natural History, Aberdeen University, since 1882,—who had previously held the Chairs of Natural History at Toronto, Dublin, and St. Andrews; many years Swiney Lecturer in Geology in the British Museum (Natural History); the well-known author of a "Manual of Palæontology," and many other important geological publications,—died, after a short illness, at his residence, Newthorpe, Queen's Road, Aberdeen, on the night of the 19th January, at the age of 55 years. His ability as a writer and lecturer, but still more his geniality and kindness of heart, attracted to him a large and attached circle of friends, who will long mourn his loss. We hope to give a suitable notice of Professor Nicholson's life and work in the March number of the Geological Magazine.—Ed. Geol. Mag.



The Edinburgh Geographical Institute J.G. Bartholomew.

FIG. 1. THE EASTERN MARGIN OF THE NORTH ATLANTIC BASIN.